



# **Influenza Epidemiology and Surveillance**

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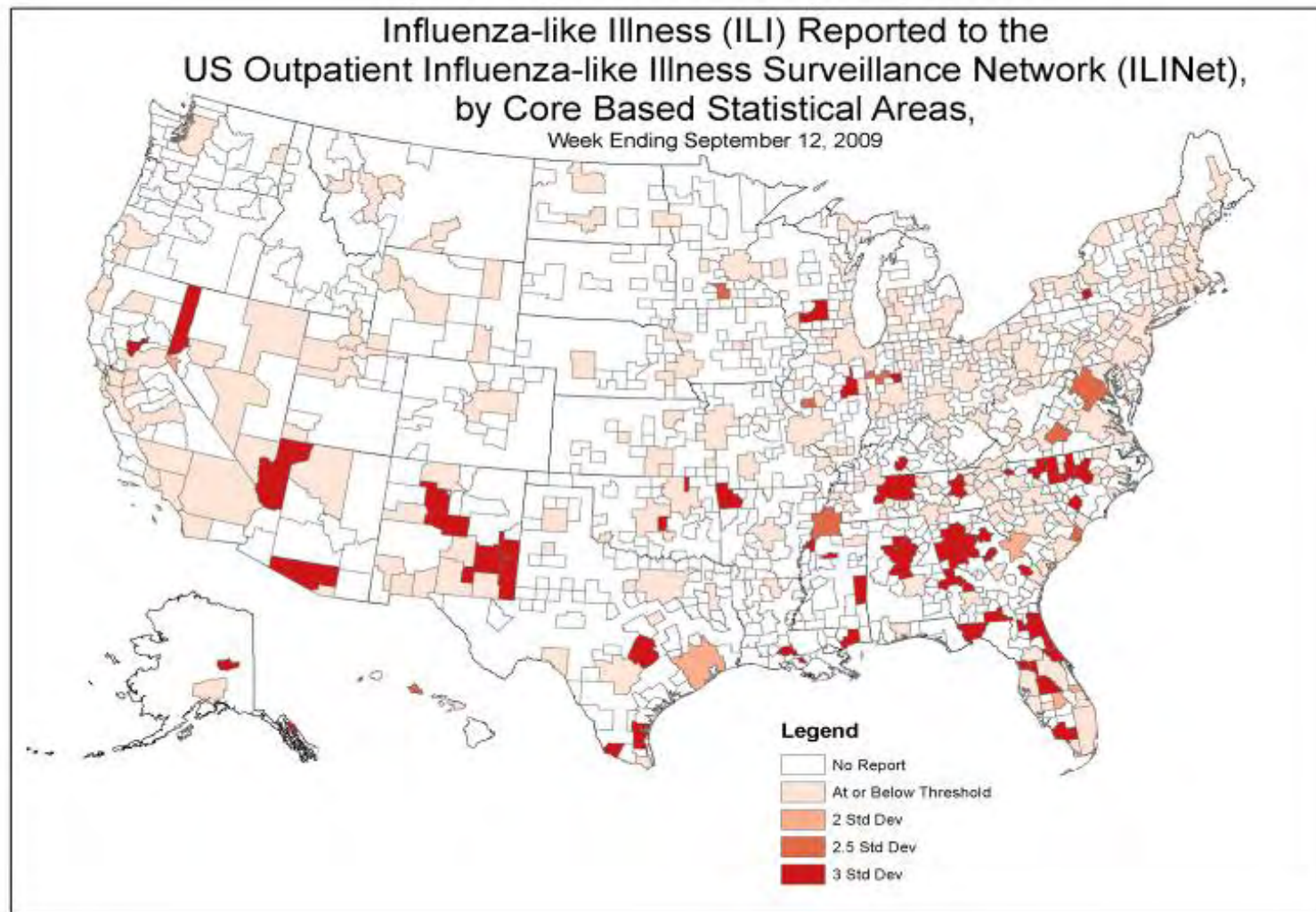
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**Ashley Fowlkes, MPH**

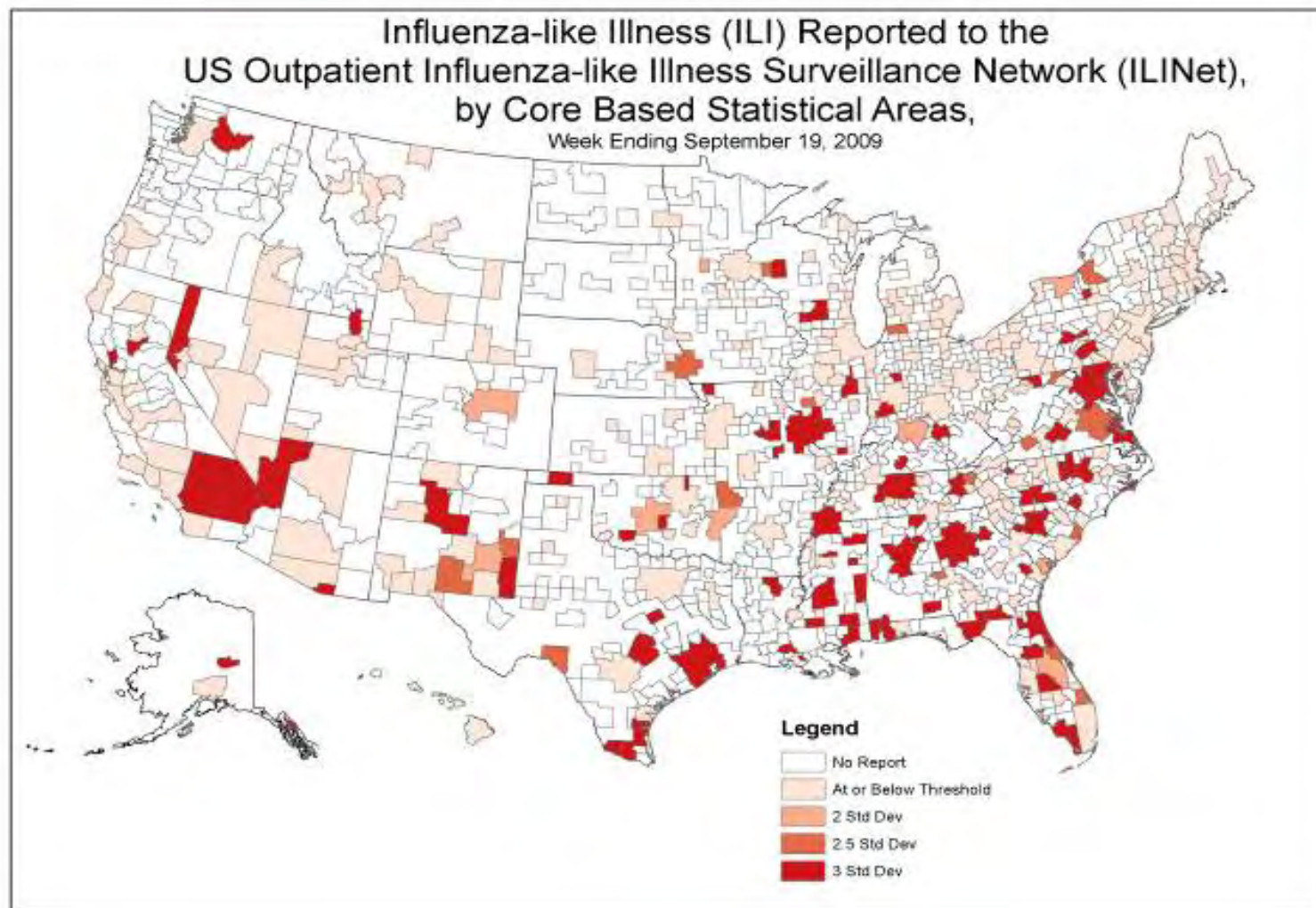
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# ILI Syndromic Surveillance

## Epidemiology/Surveillance

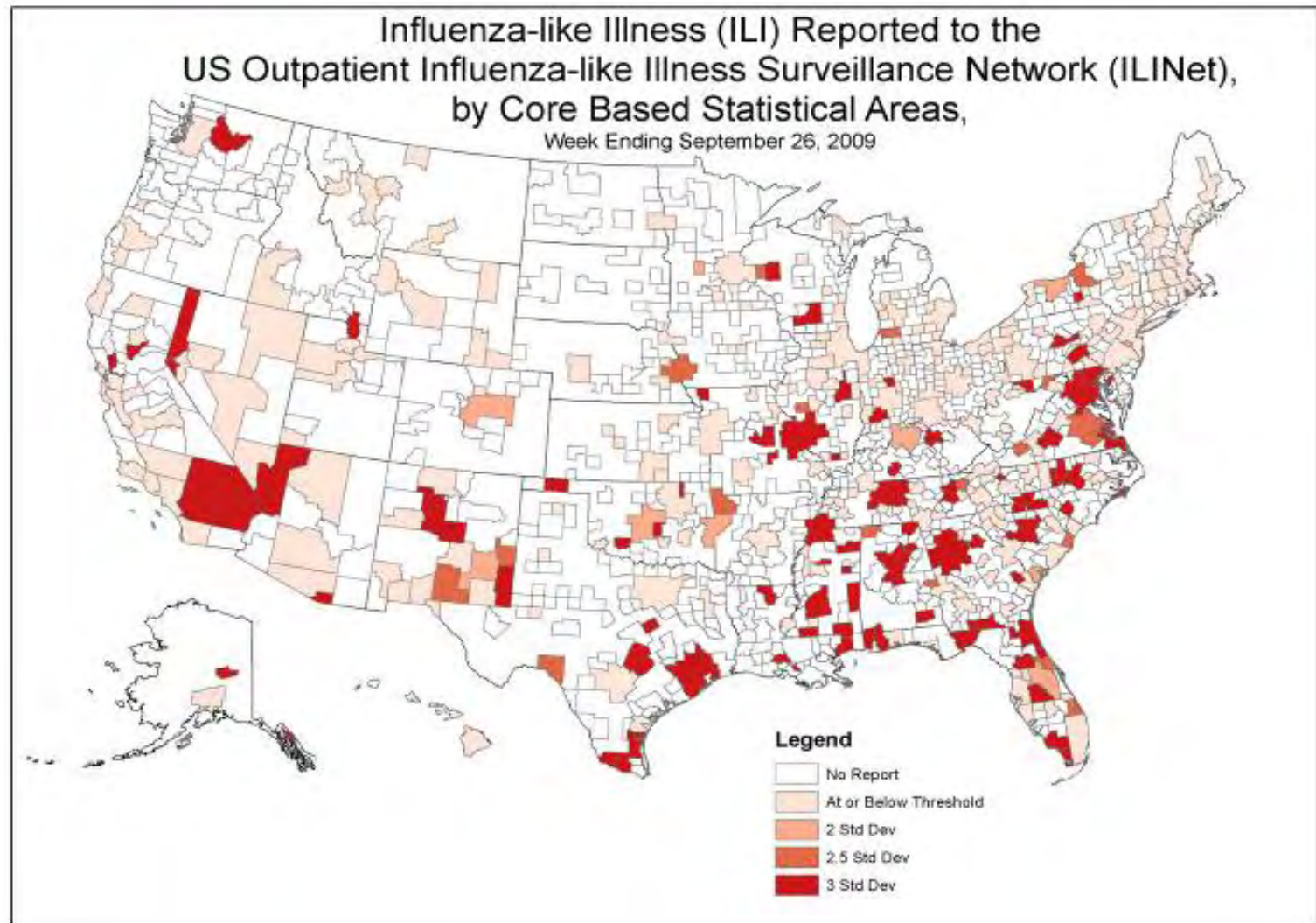


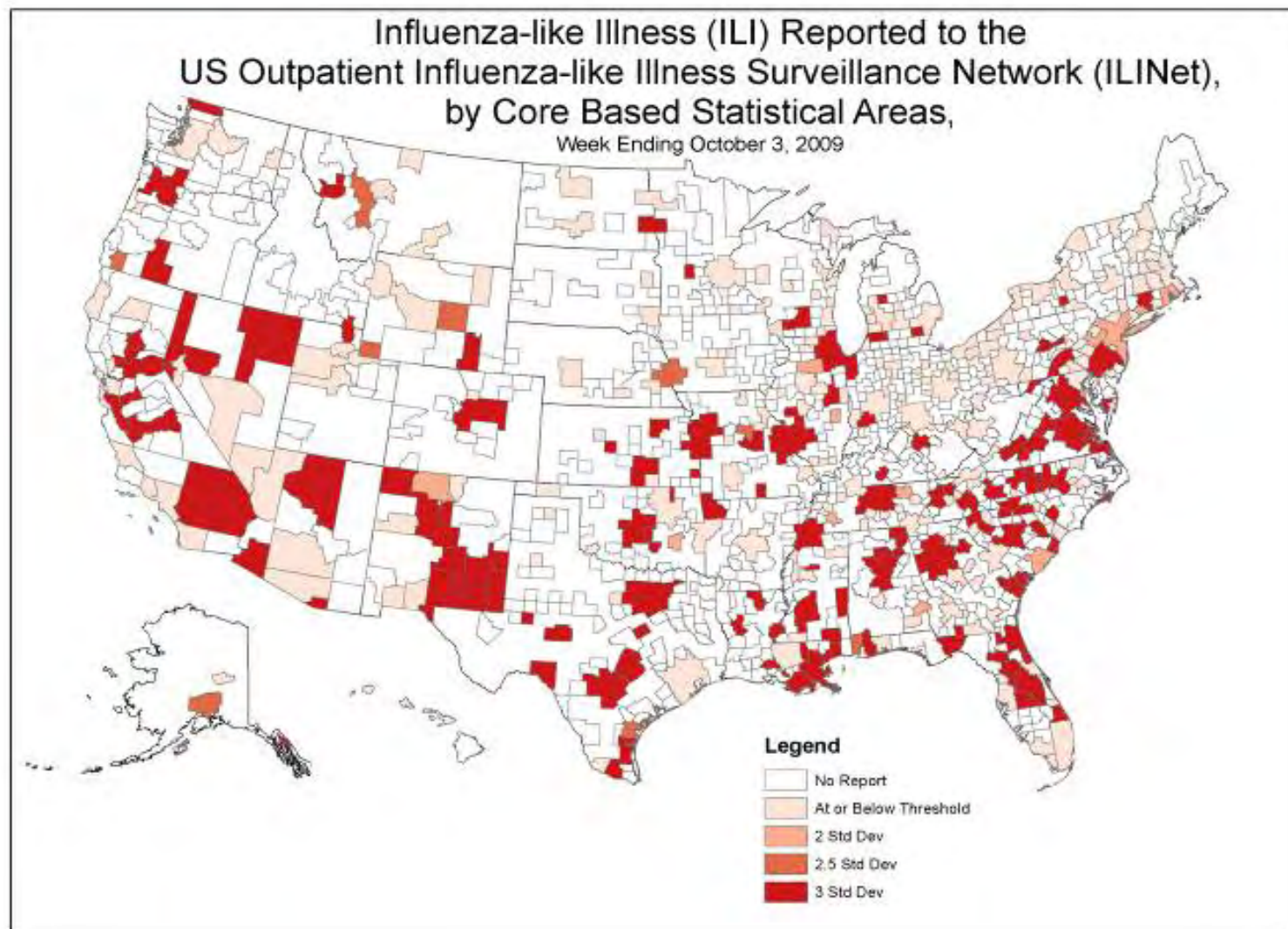
## Epidemiology/Surveillance

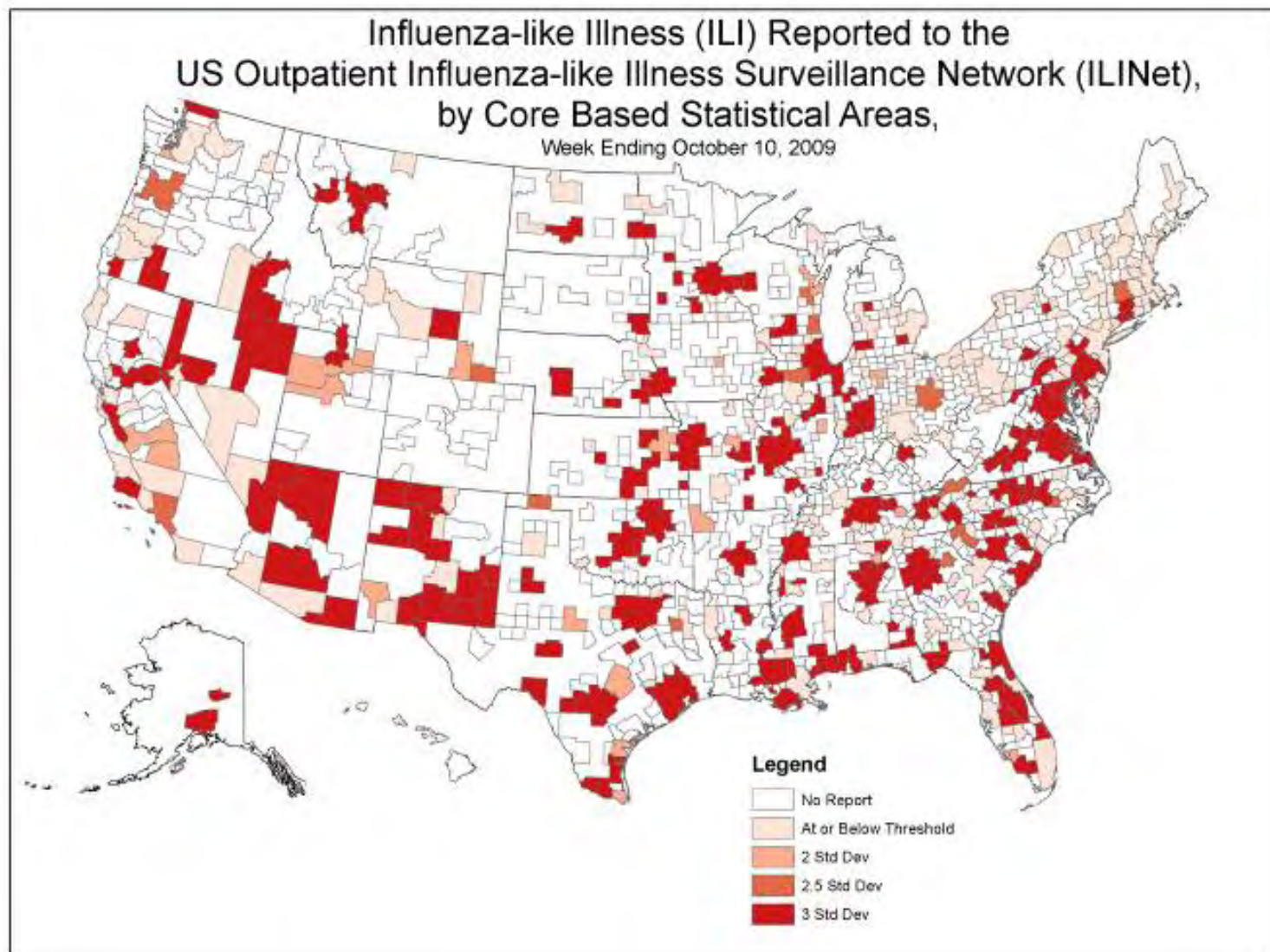




## Epidemiology/Surveillance



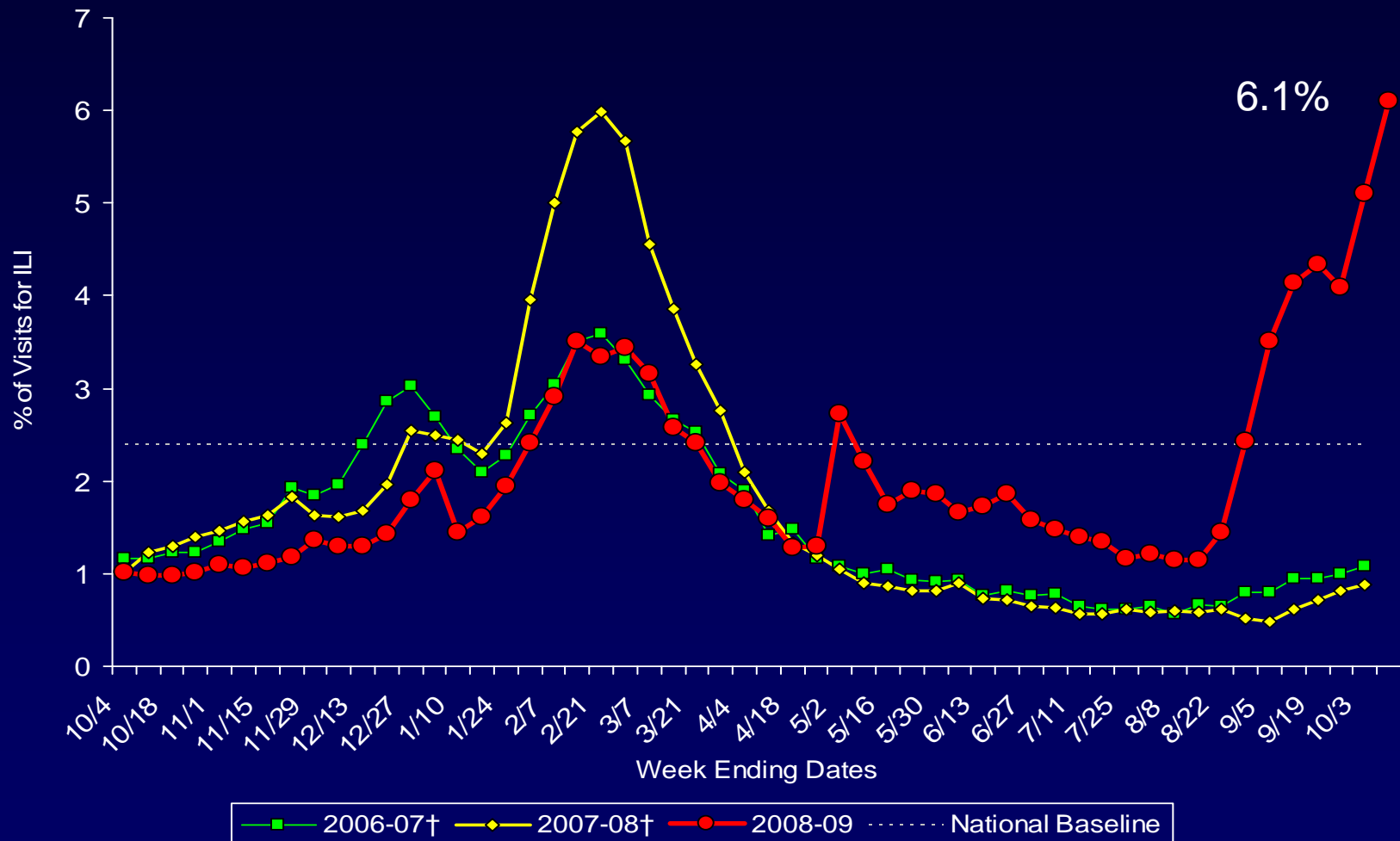






# Epidemiology/Surveillance

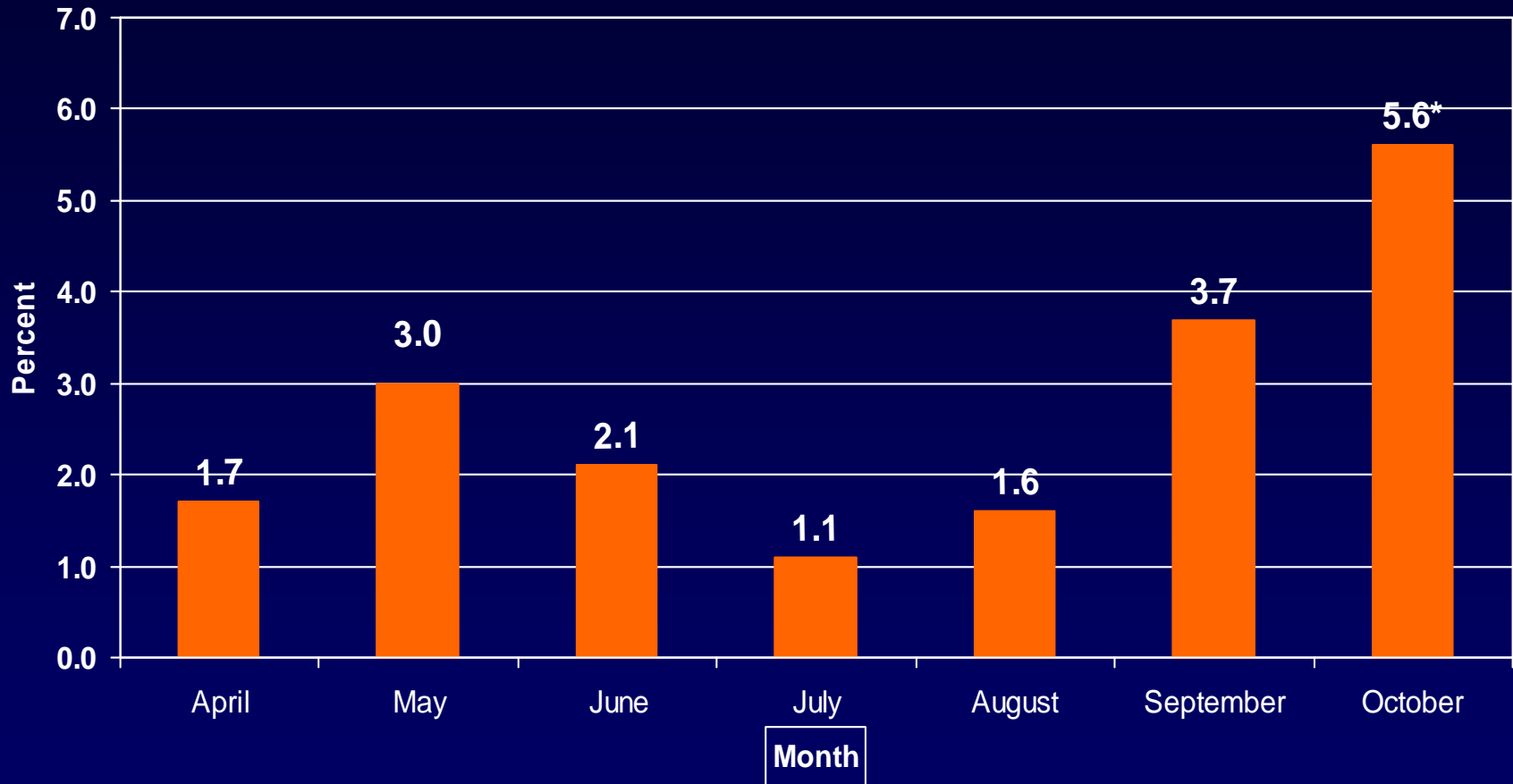
## Percentage of Visits for Influenza-like Illness (ILI) Reported by the *U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet)*, National Summary 2008-09 and Previous Two Seasons





# Epidemiology/Surveillance

## ILINet - Percent ILI by Month, 2009

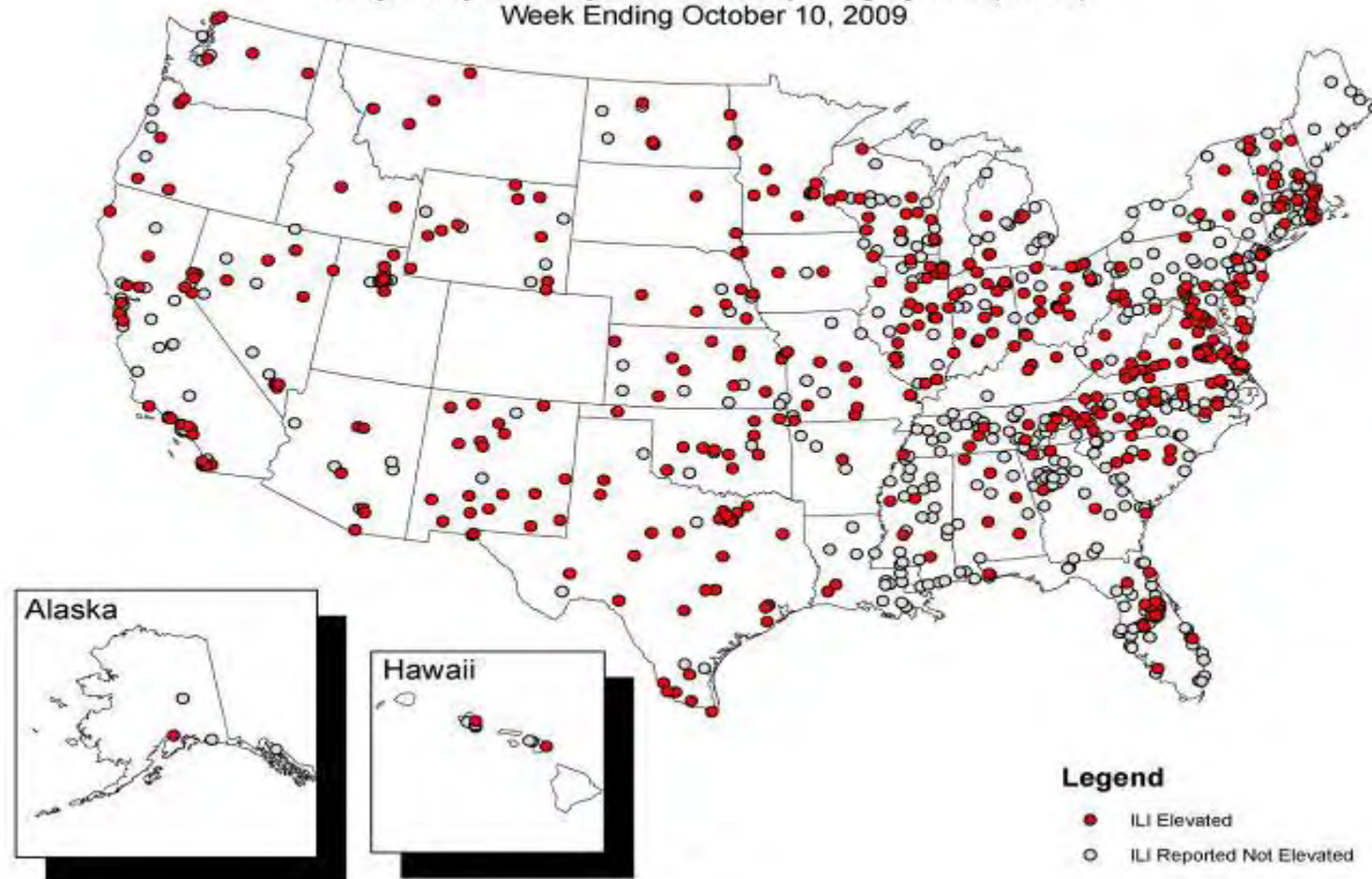


\*Preliminary

■ % ILI (Unweighted)

# Epidemiology/Surveillance

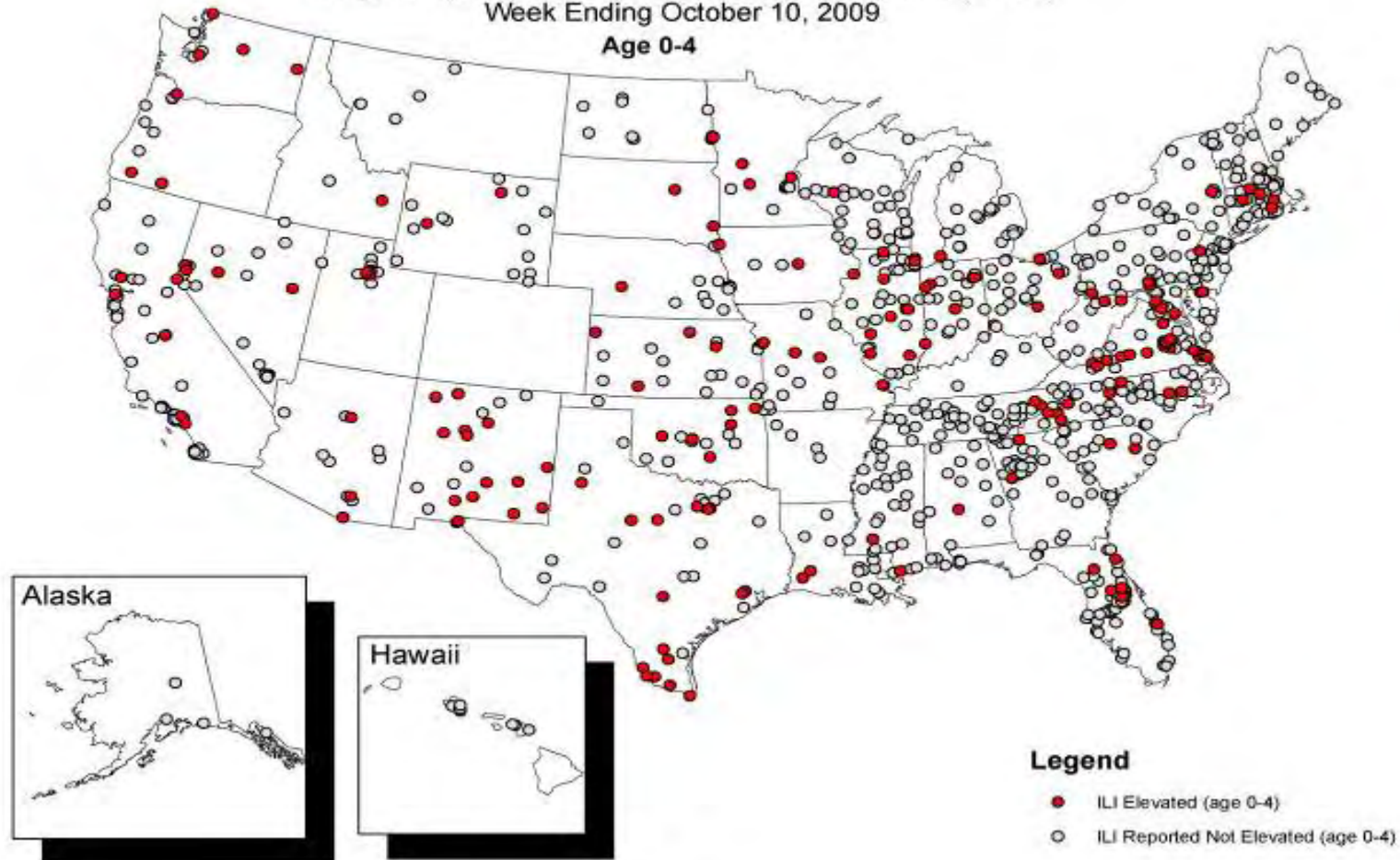
Influenza-like Illness (ILI) Reported from U.S. Outpatient Influenza-like Illness  
Surveillance Network (ILINet)  
Analyzed by the Early Aberration Reporting System (EARS)  
Week Ending October 10, 2009



# Epidemiology/Surveillance

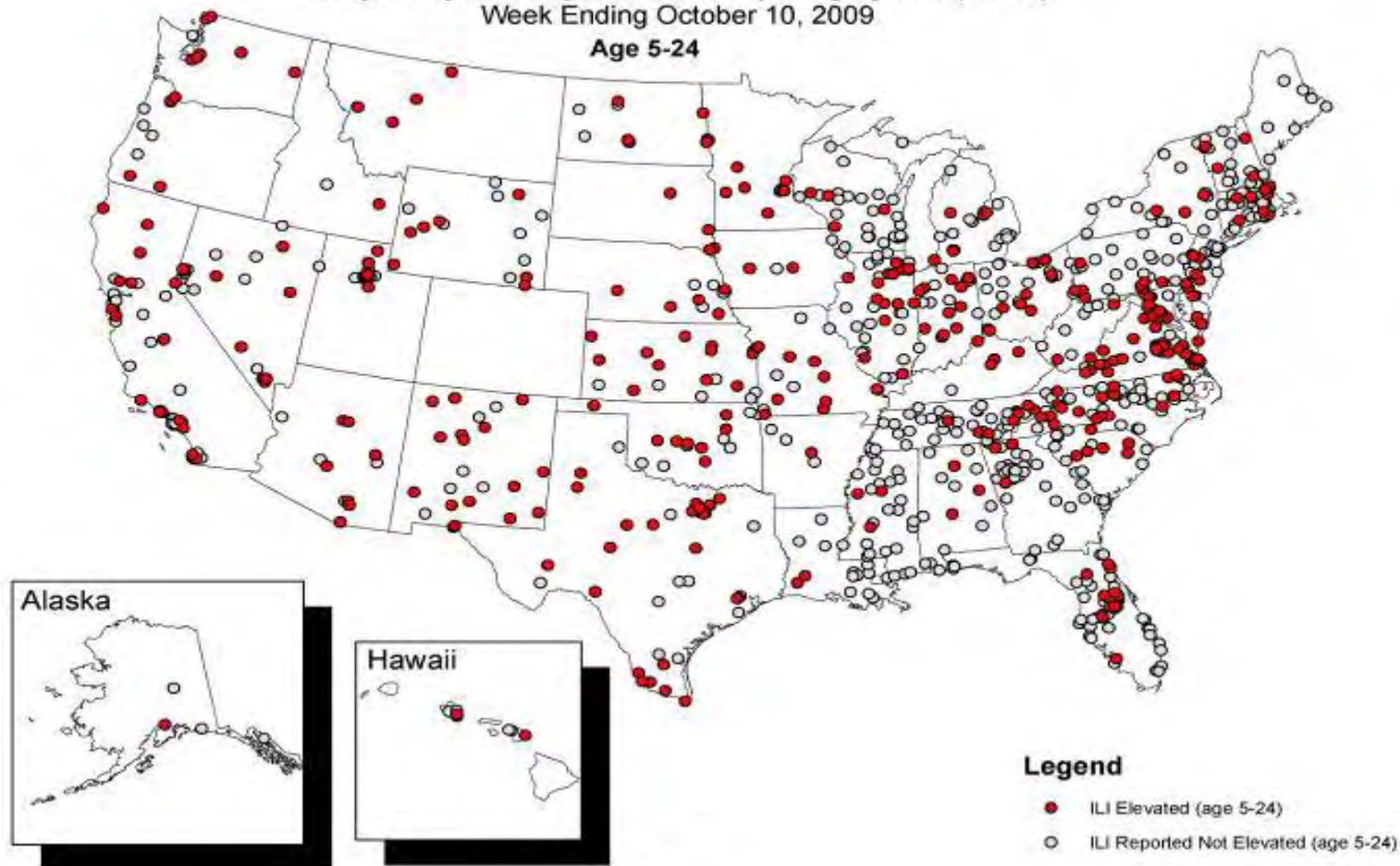
Influenza-like Illness (ILI) Reported from U.S. Outpatient Influenza-like Illness  
Surveillance Network (ILINet)  
Analyzed by the Early Aberration Reporting System (EARS)  
Week Ending October 10, 2009

Age 0-4



# Epidemiology/Surveillance

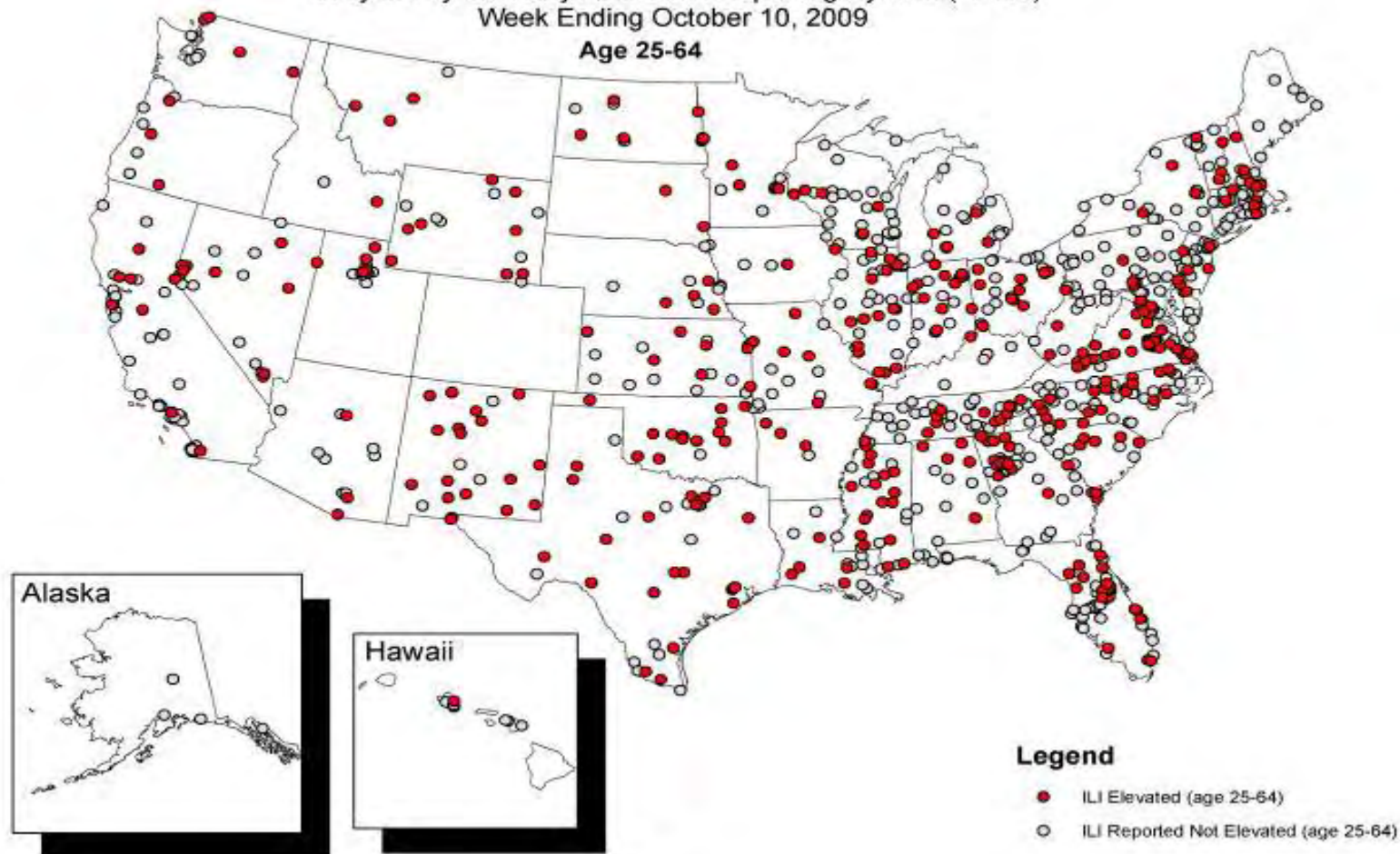
Influenza-like Illness (ILI) Reported from U.S. Outpatient Influenza-like Illness  
Surveillance Network (ILINet)  
Analyzed by the Early Aberration Reporting System (EARS)  
Week Ending October 10, 2009  
**Age 5-24**





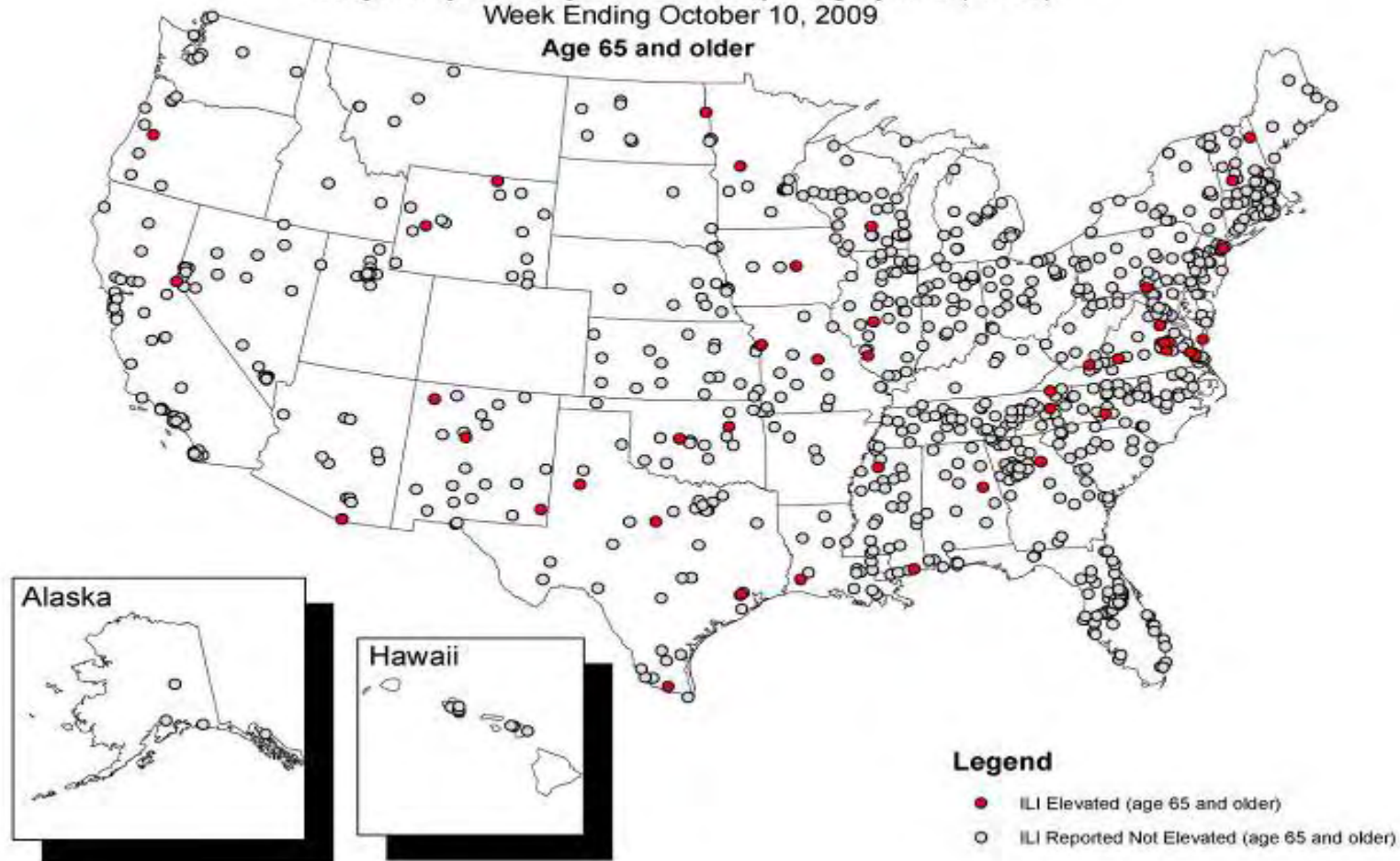
# Epidemiology/Surveillance

Influenza-like Illness (ILI) Reported from U.S. Outpatient Influenza-like Illness  
Surveillance Network (ILINet)  
Analyzed by the Early Aberration Reporting System (EARS)  
Week Ending October 10, 2009  
**Age 25-64**



# Epidemiology/Surveillance

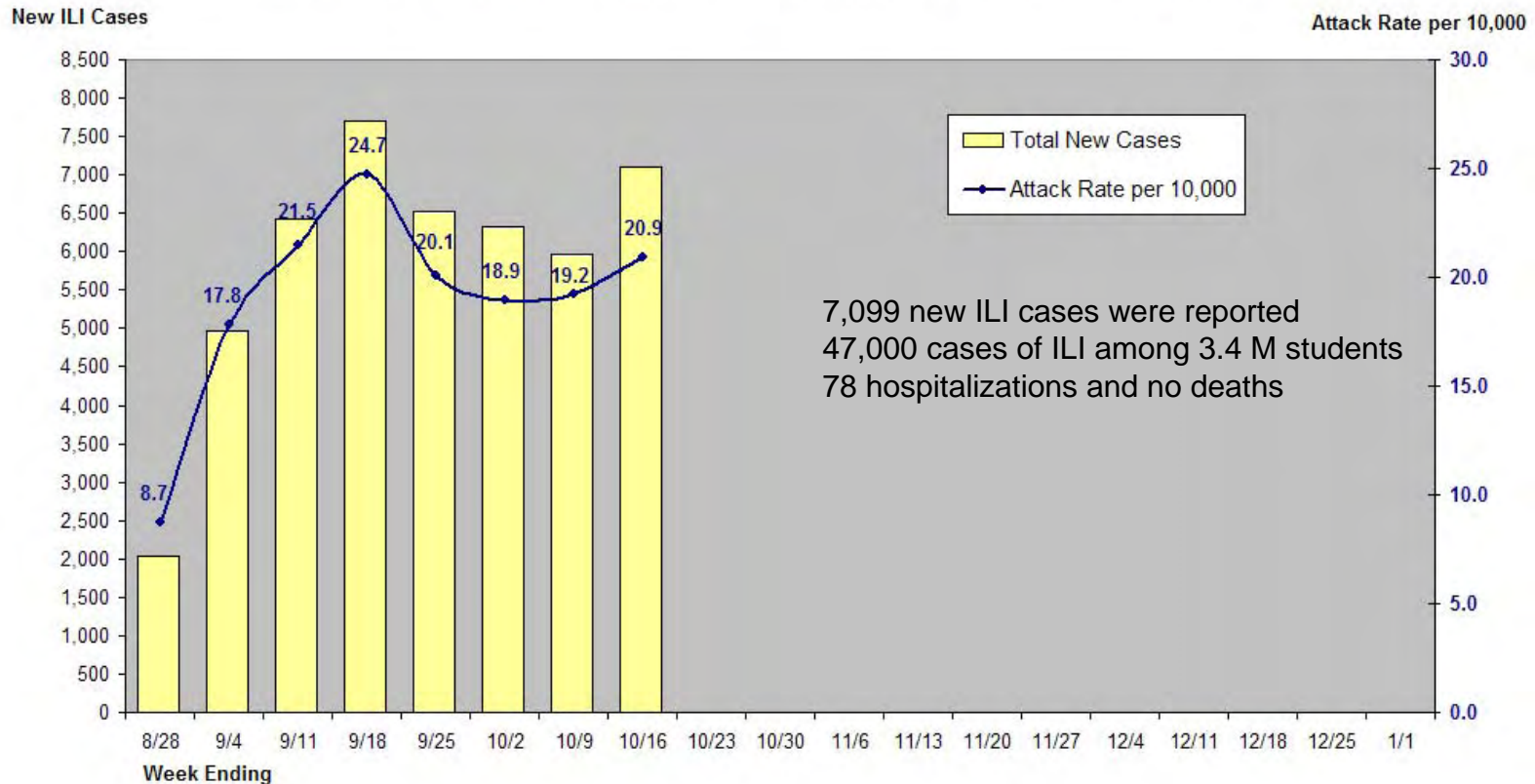
Influenza-like Illness (ILI) Reported from U.S. Outpatient Influenza-like Illness  
Surveillance Network (ILINet)  
Analyzed by the Early Aberration Reporting System (EARS)  
Week Ending October 10, 2009  
**Age 65 and older**



# Epidemiology/Surveillance

## ACHA ILI Surveillance

Fall 2009 - College Influenza Like Illness (ILI) Incidence Epicurve

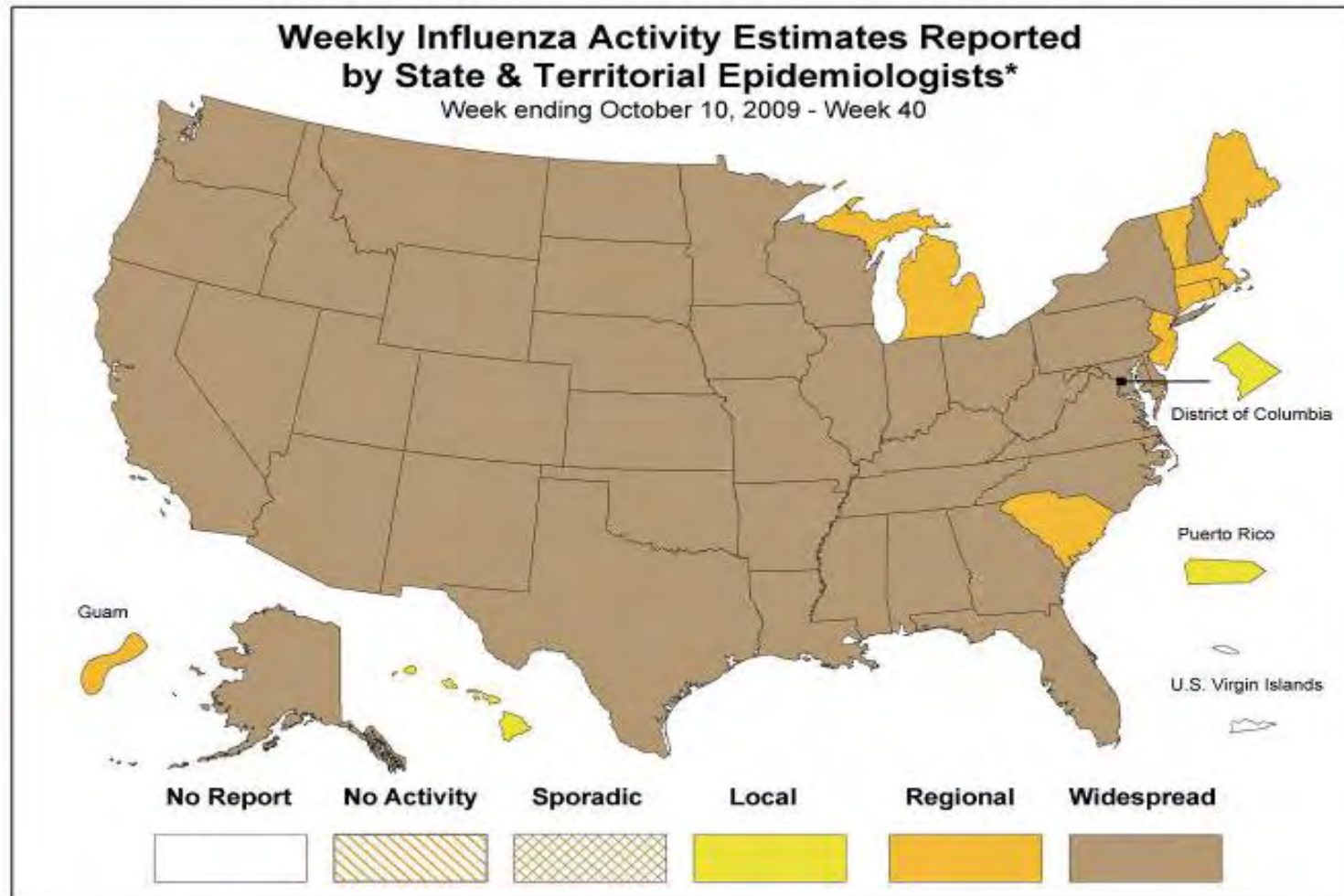


American College Health Association

**Limitations:** Case counts and rates do not represent the complete incidence of ILI in the population, nor the incidence of ILI among all institutions of higher education. The case counts and rates only represent those institutions of higher education that participate in the ACHA surveillance program.



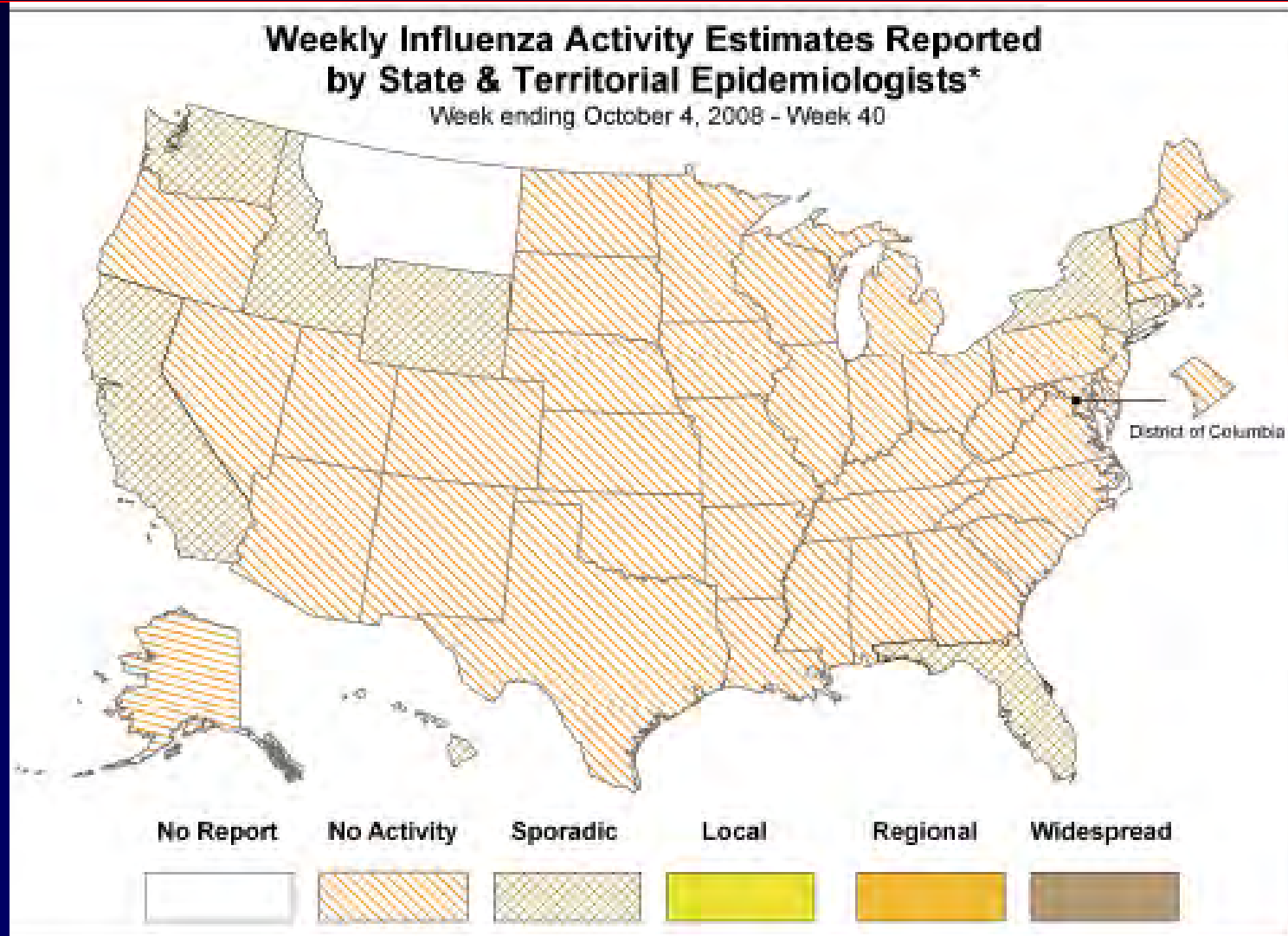
Epidemiology/Surveillance  
***Weekly Influenza Activity Reported by SLTT's***



\* This map indicates geographic spread & does not measure the severity of influenza activity



Epidemiology/Surveillance  
***Weekly Influenza Activity Reported by SLTT's***



# Epidemiology/Surveillance

## Severity: H1N1 2009

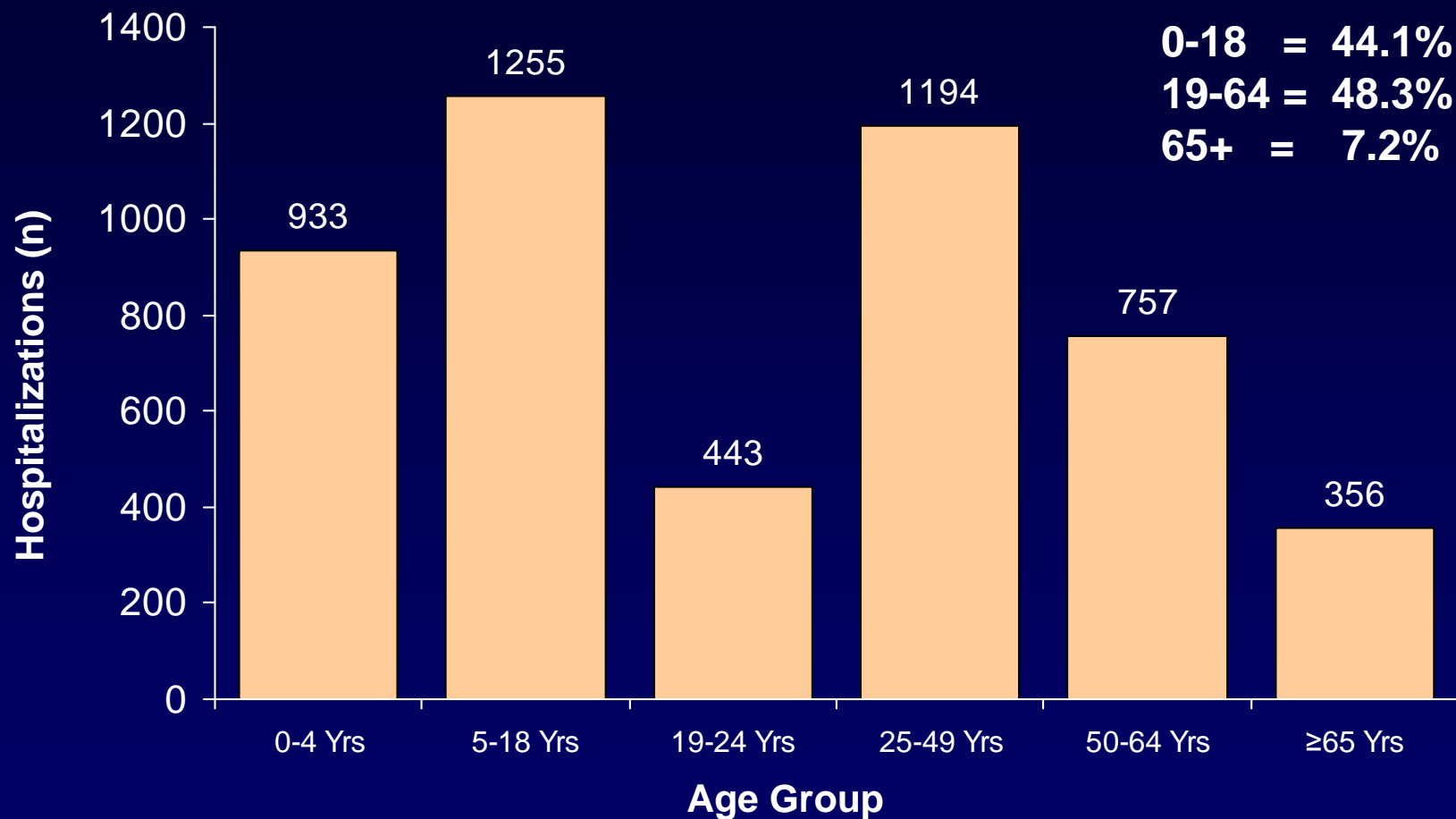
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**Seasonal  
Severity**

# Hospitalization

**Epidemiology/Surveillance**  
**Lab-Confirmed Hospitalizations by Age Group through Week 40 (n=4,958)\***  
**Influenza Week 40 – 16 OCT 2009**

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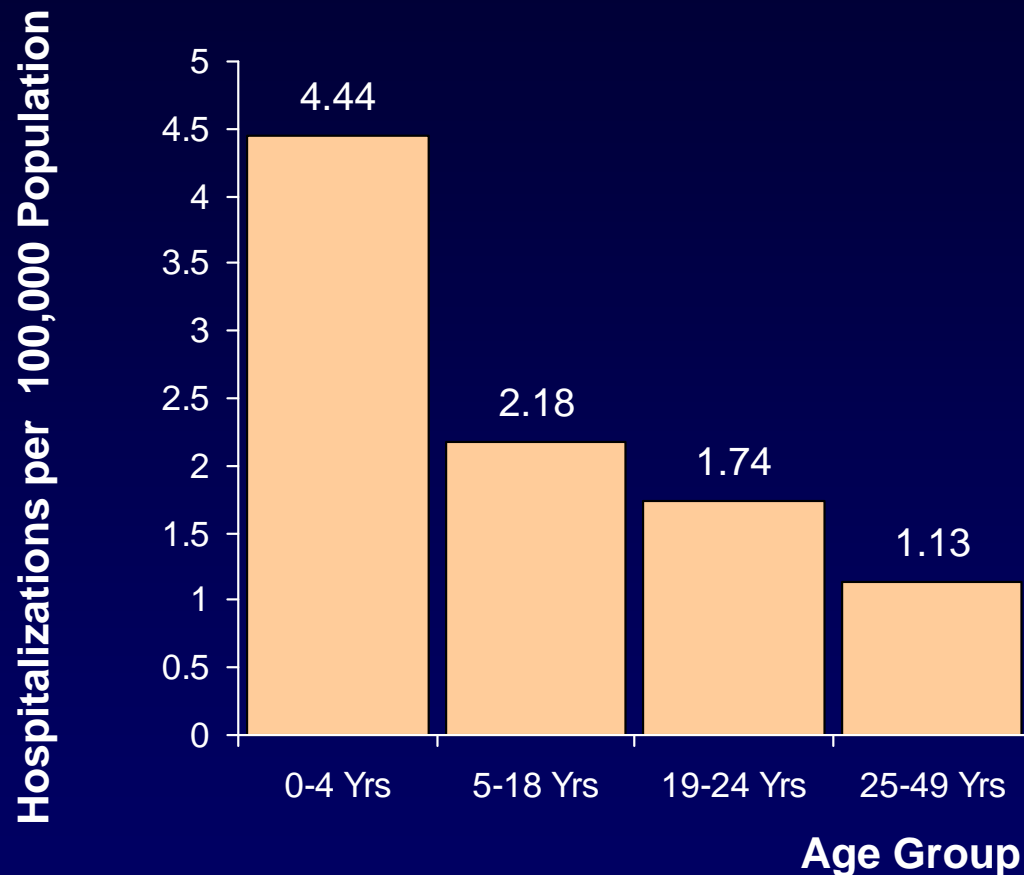


\*Numbers are cumulative from start of MMWR week 35 (August 30, 2009)



## Epidemiology/Surveillance

Lab-Confirmed Hospitalization Rates per 100,000 Population by Age Group through Week 40 (n=4,938\*)  
Influenza Week 40 – 16 OCT 2009



28 states reporting lab- confirmed  
influenza hospitalization

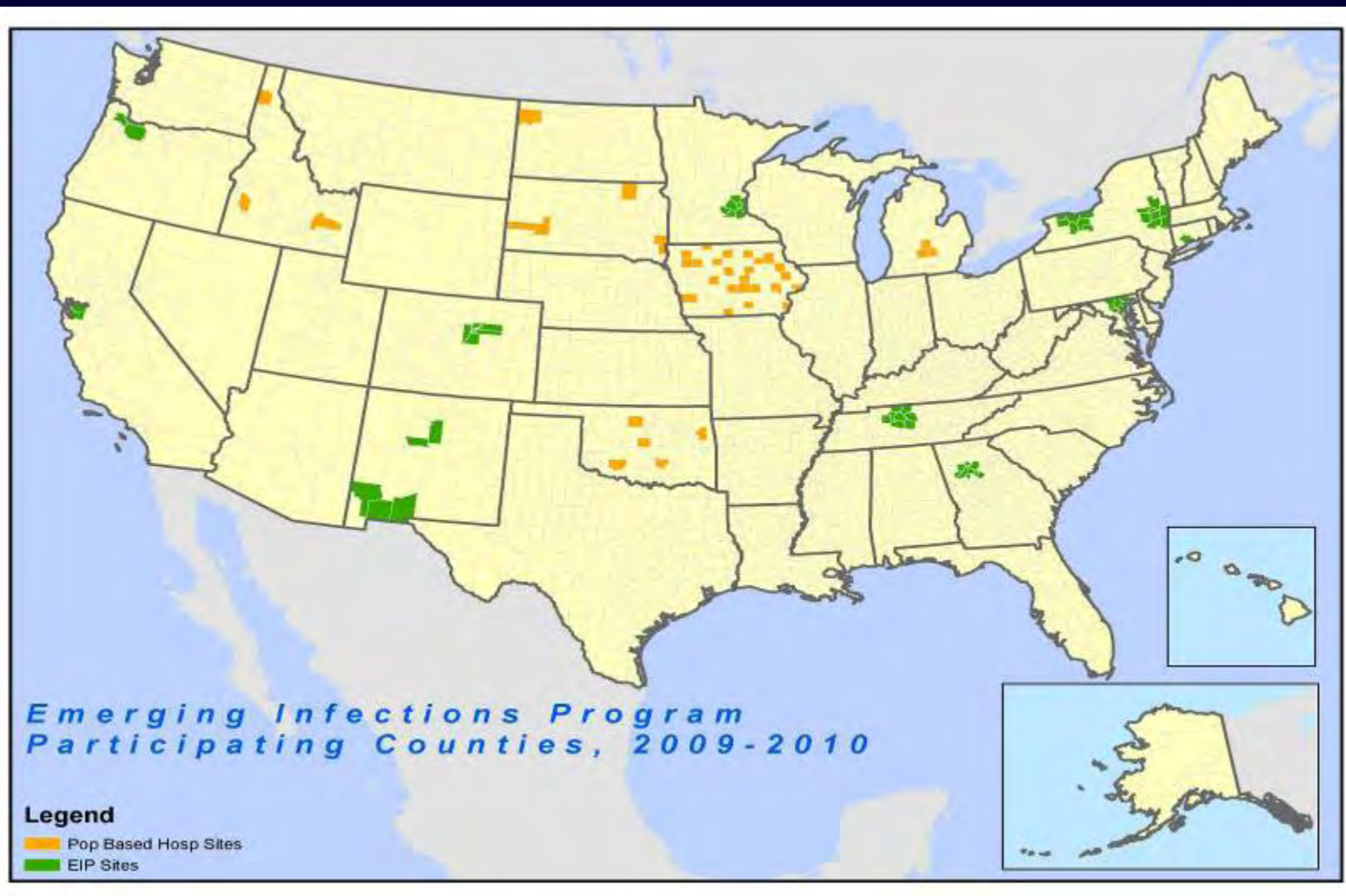
\*Hospitalizations with unknown ages are not included (n=20).

Rate / 100,000 by Single Year Age Groups: Denominator source: 2008 Census Estimates, U.S. Census Bureau at:

<http://www.census.gov/popest/national/asrh/files/NC-EST2007-ALLDATA-R-File24.csv>



# Laboratory-Confirmed Influenza Hospitalization Surveillance, 2009-2010

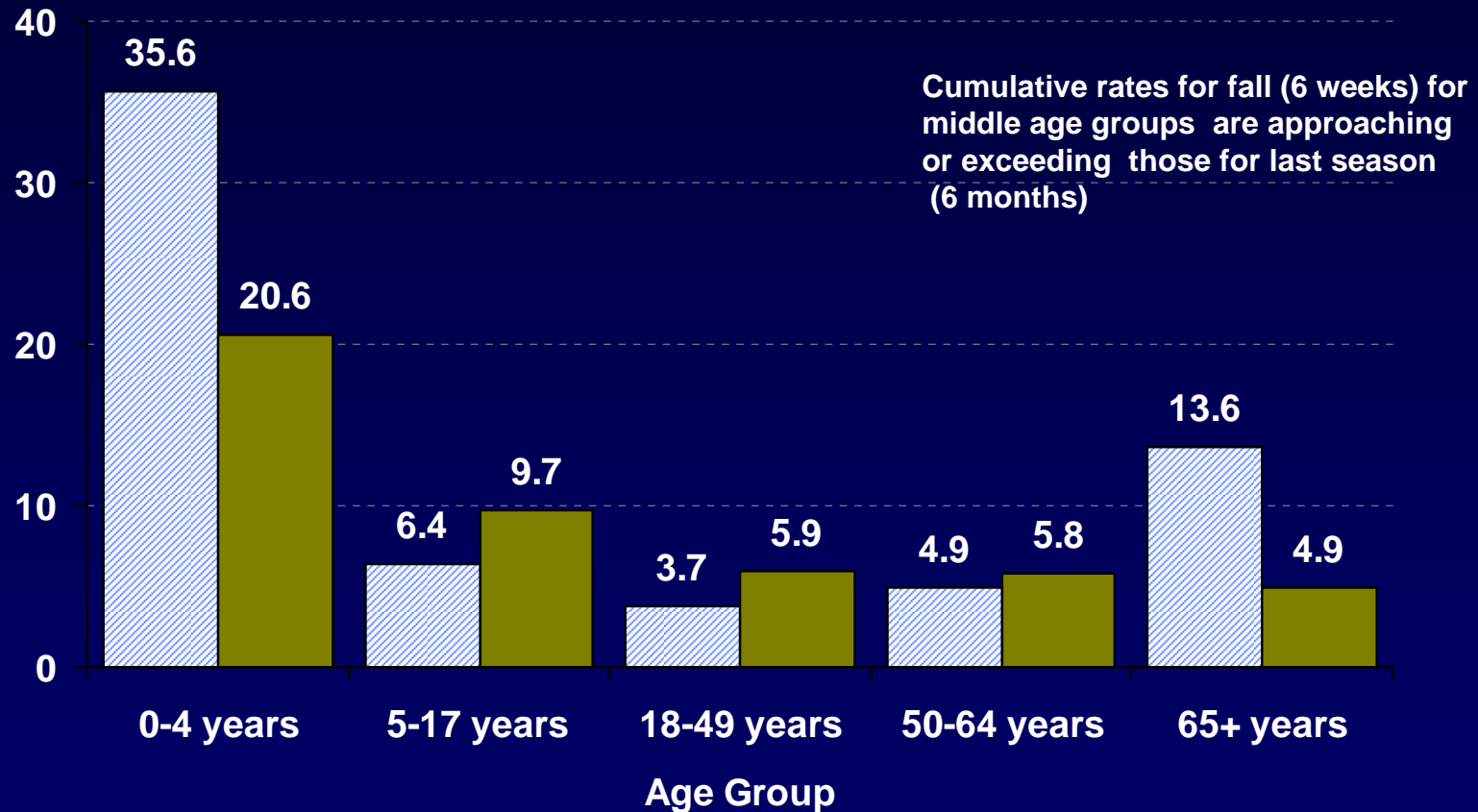


Pop-Based Hosp Sites (3.5 million)  
Emerging Infections Program Sites (22.1 million)

Epidemiology/Surveillance  
Cumulative Seasonal Influenza Hospitalization Rates by Age,  
Population-Based sites

**Hospitalizations Rates**  
**(EIP 2008-09 and Network 2009-10 seasons)**

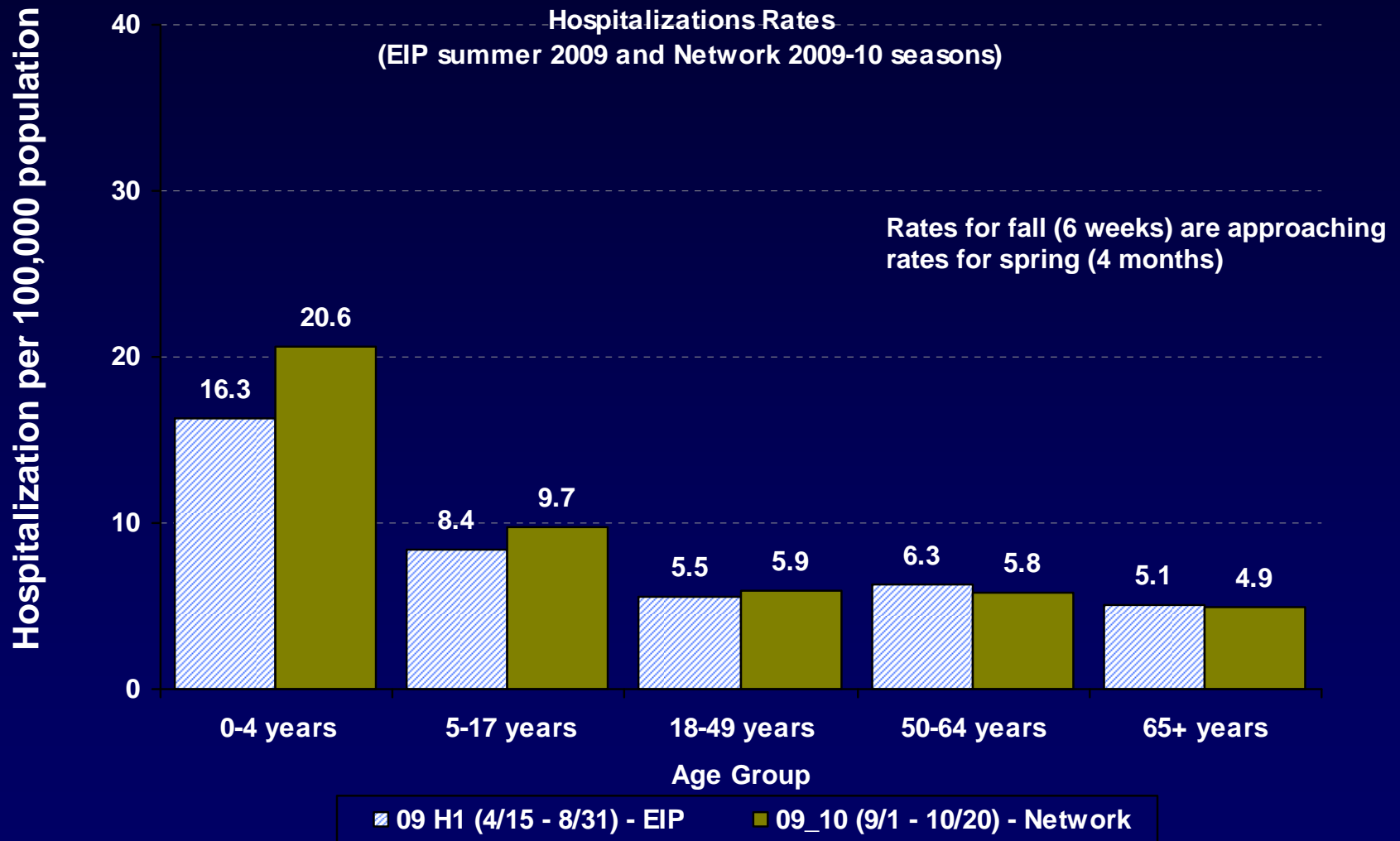
Hospitalization per 100,000 population



■ 08\_09 (10/1- 4/14) - H1N1 Predominant ■ 09\_10 (9/1 - 10/20) - Network

# Epidemiology/Surveillance

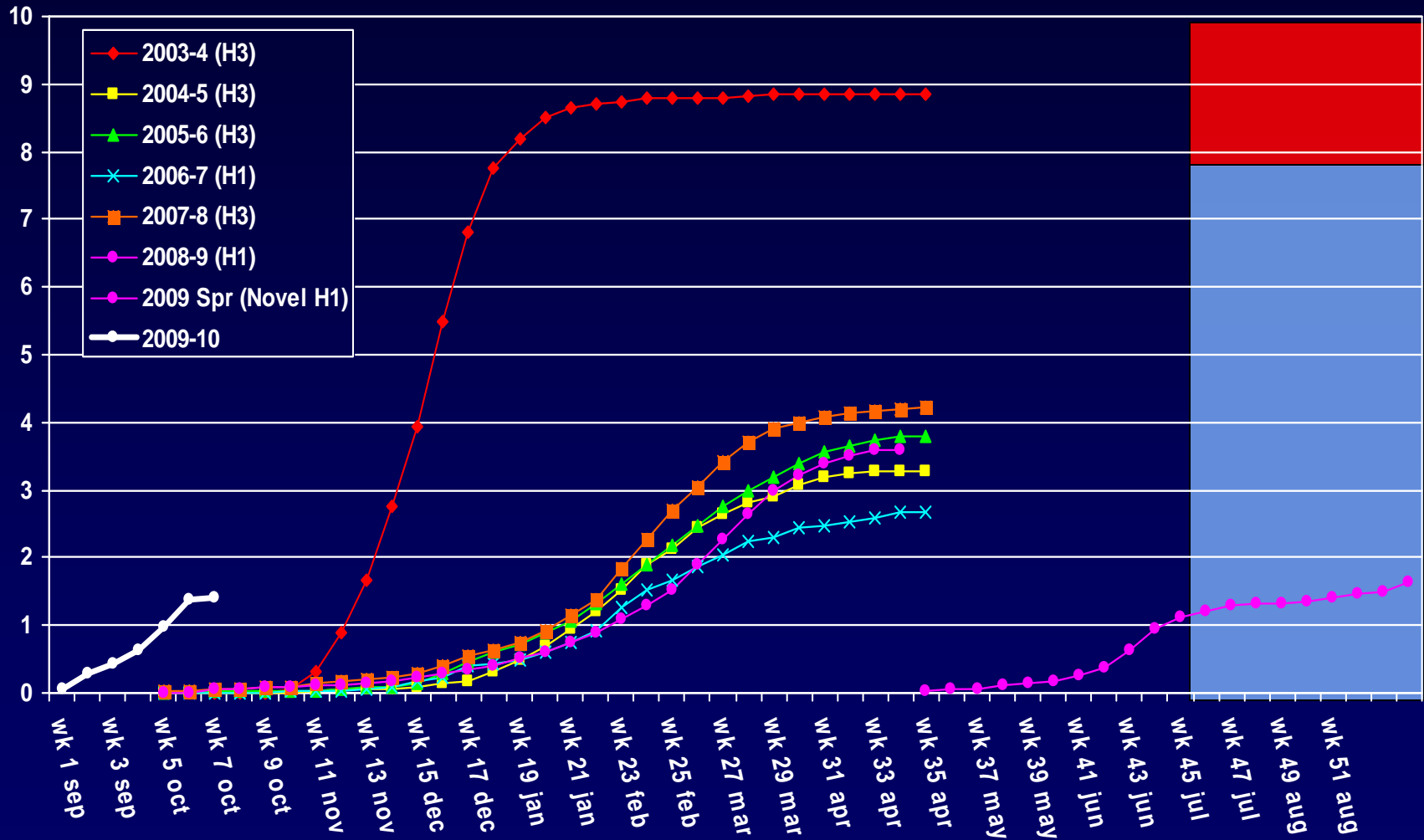
## Cumulative Seasonal Influenza Hospitalization Rates by Age, Population-Based sites





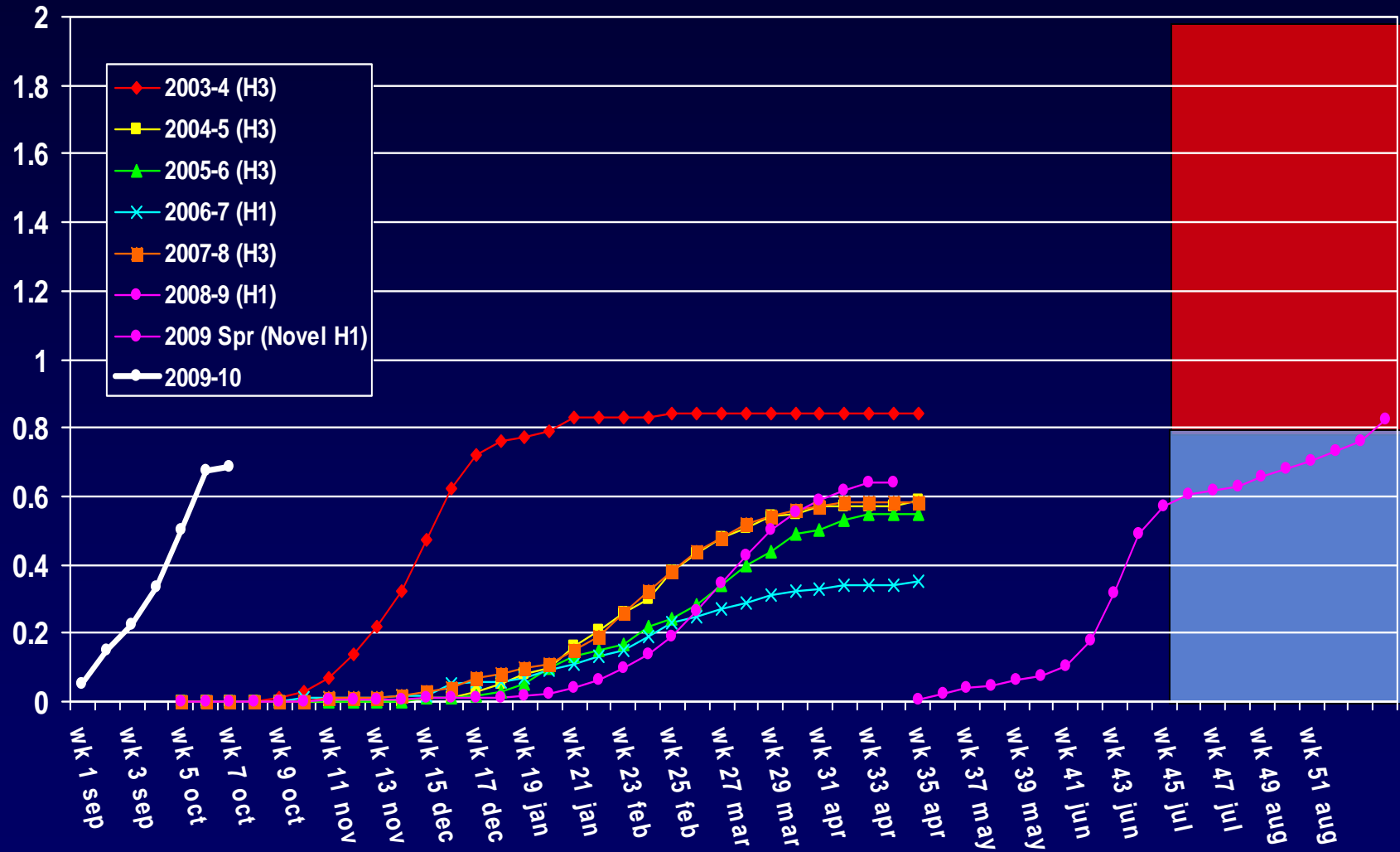
# Epidemiology/Surveillance

## Cumulative rate of hospitalization/ 100,000 population ages 0-4, EIP, 2003-2009



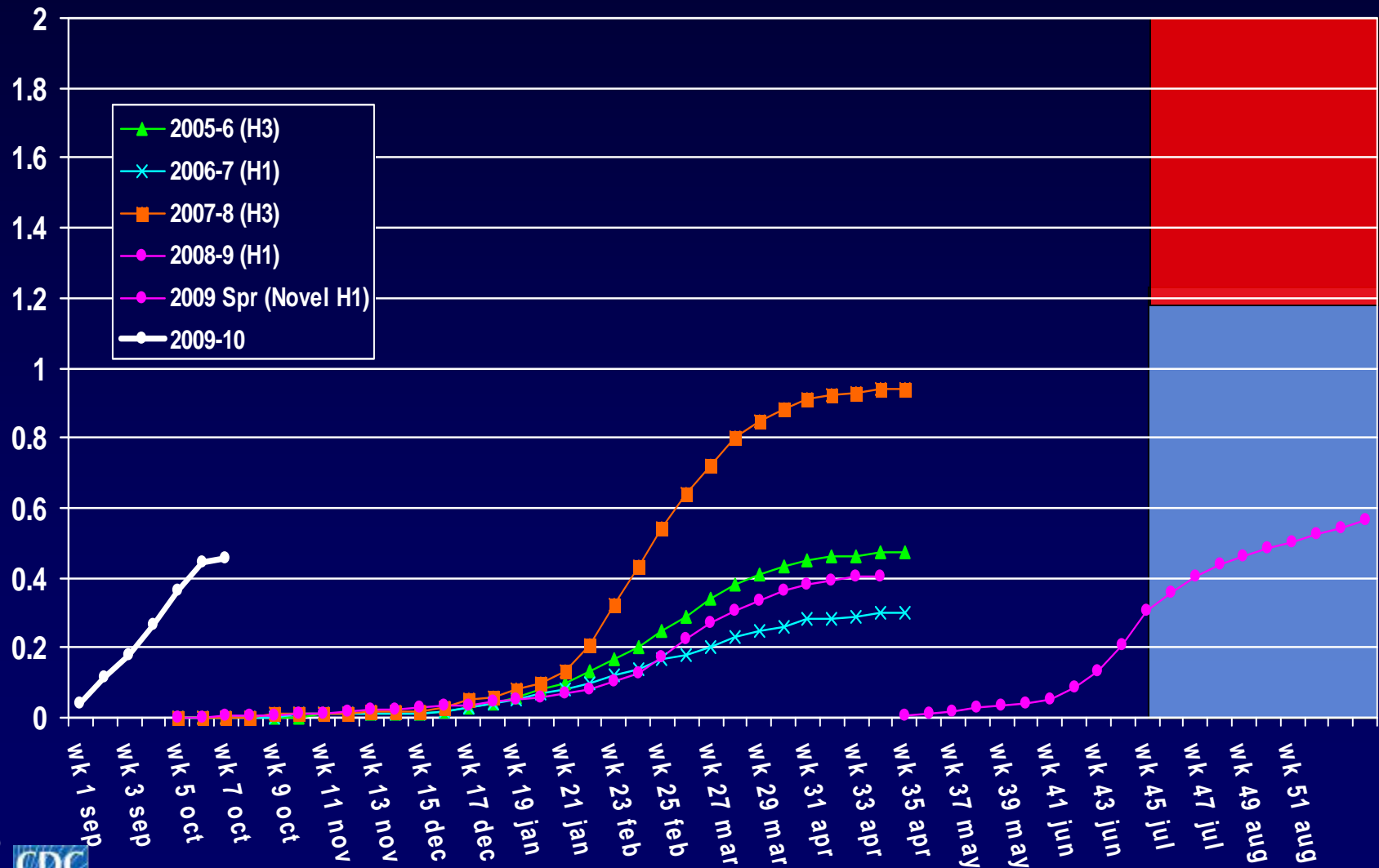
# Epidemiology/Surveillance

## Cumulative rate of hospitalization/ 100,000 population ages 5-17, EIP, 2003-2009



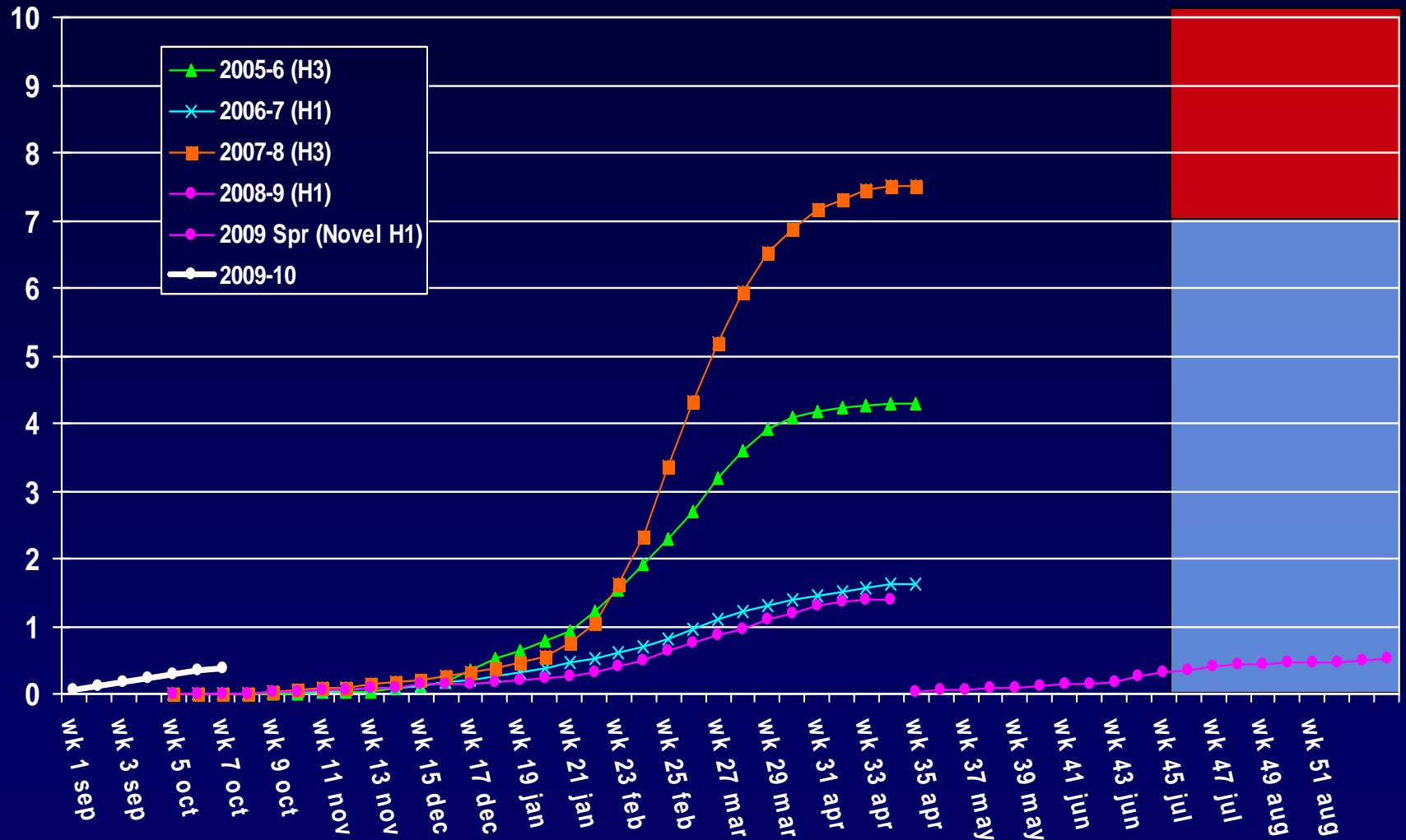
# Epidemiology/Surveillance

## Cumulative rate of hospitalization/ 100,000 population ages 18-64, EIP, 2005-2009



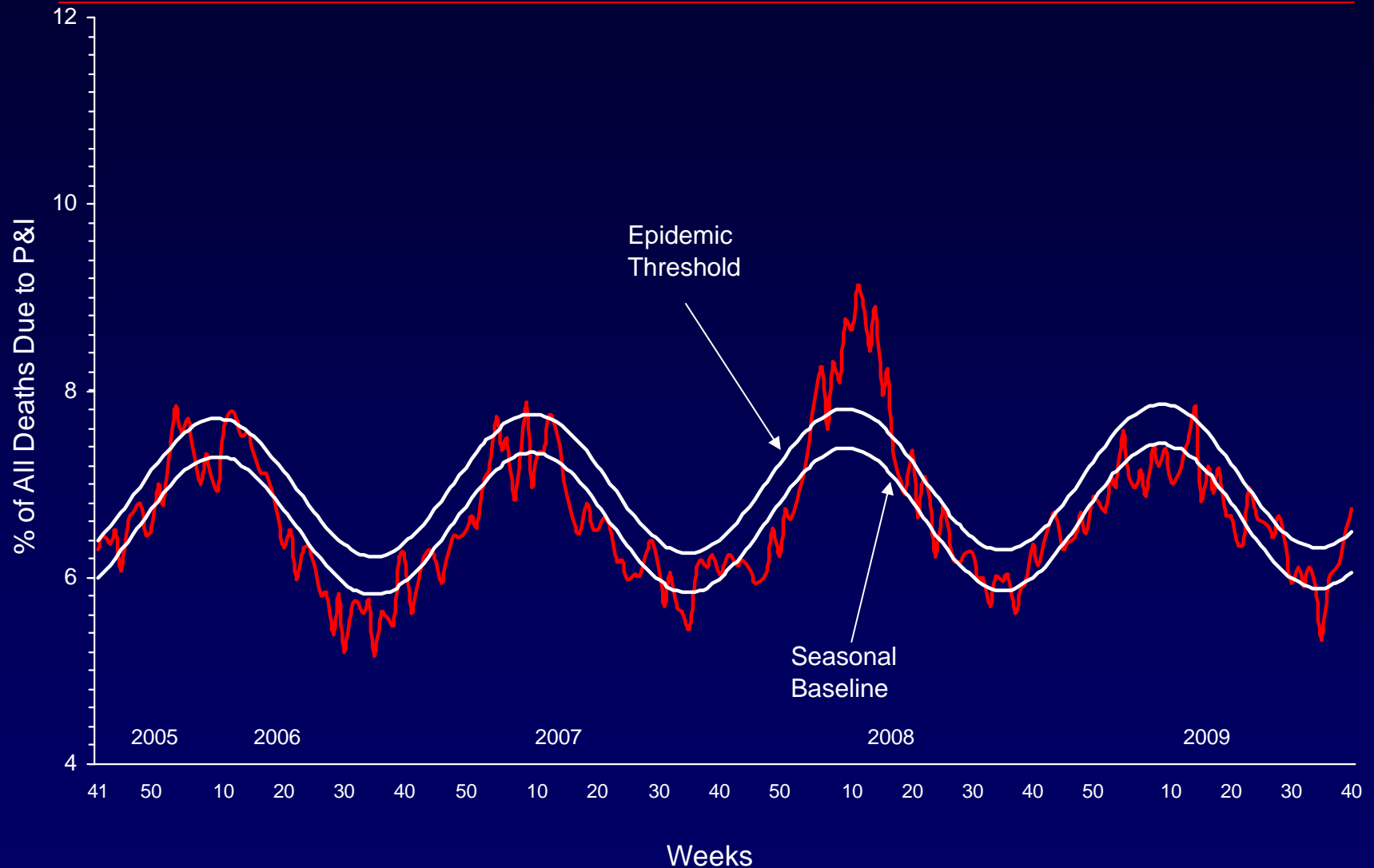
# Epidemiology/Surveillance

## Cumulative rate of hospitalization/ 100,000 population ages 65+, EIP, 2005-2009



# Mortality

***Pneumonia and Influenza Mortality for 122 U.S. Cities -Week Ending 10 OCT 2009***

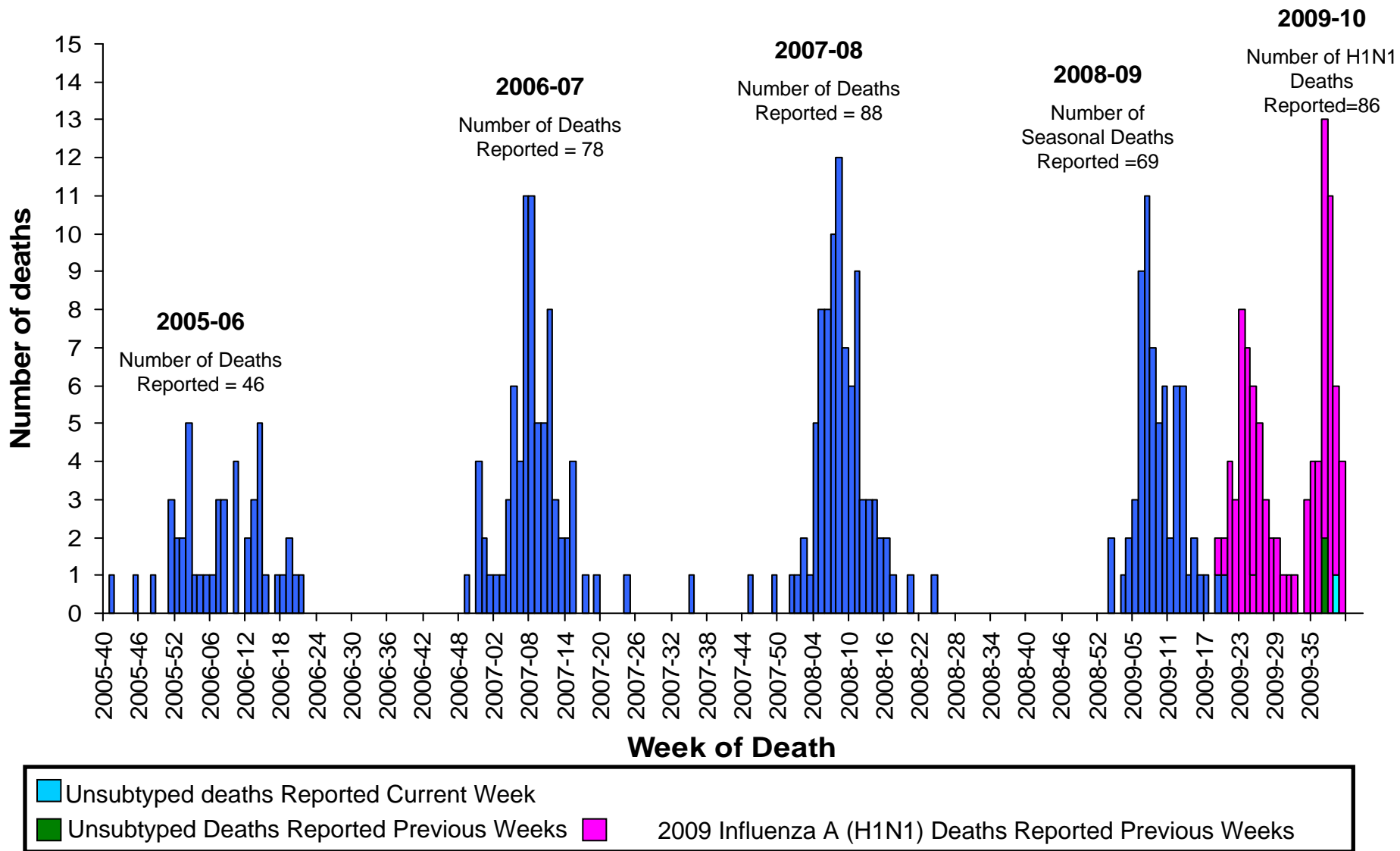




# Epidemiology/Surveillance

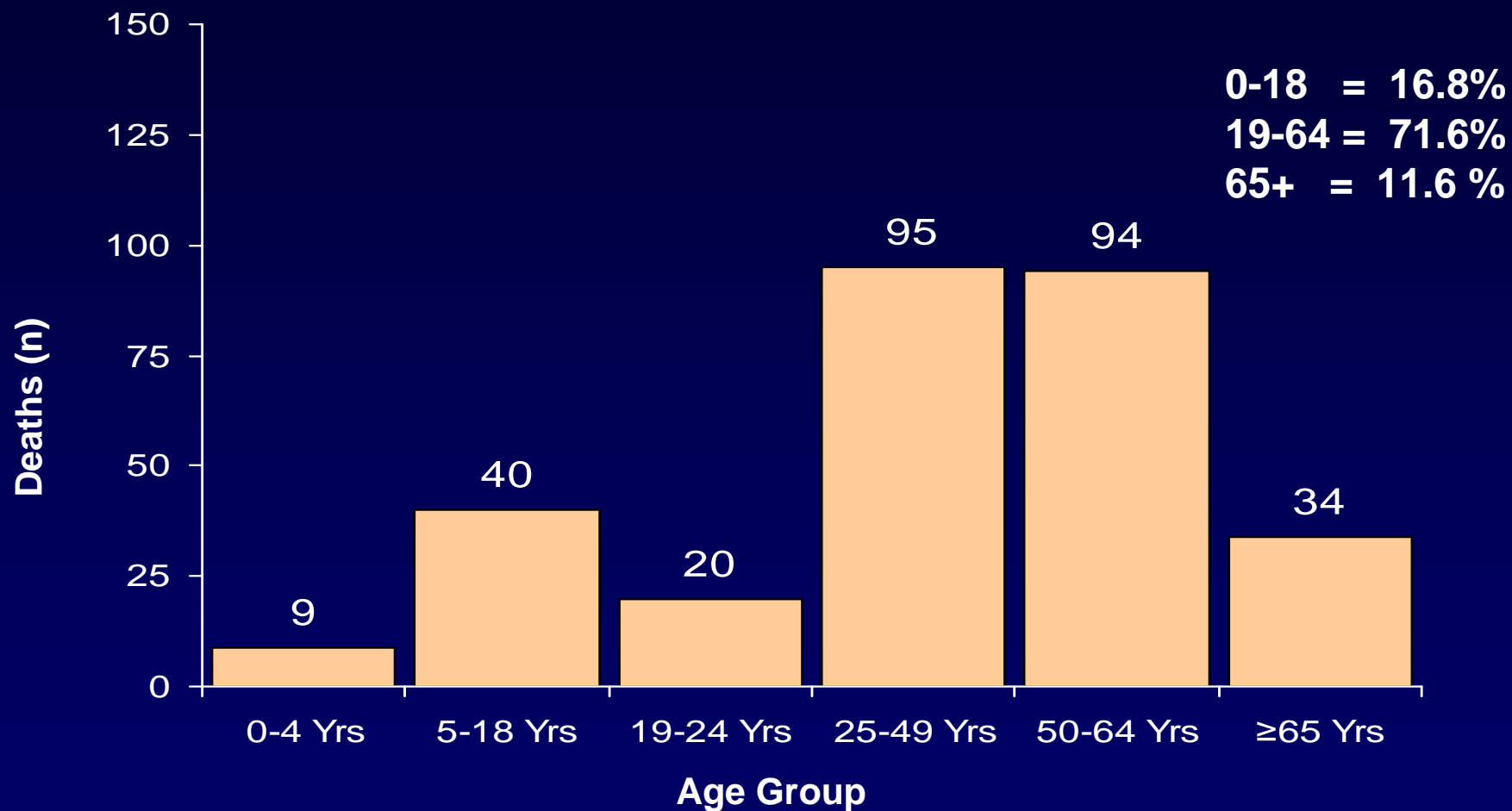
## Number of Influenza-Associated Pediatric Deaths by Week of Death:

### 2005-06 season to present



**Epidemiology/Surveillance**  
**Lab-Confirmed Deaths by Age Group through Week 40 (n=292\*)**  
**Influenza Week 40 – 16 OCT 2009**

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\*Numbers are cumulative from start of MMWR week 35 (August 30, 2009)

**Epidemiology/Surveillance**  
**Lab-Confirmed Mortality per 100,000 Population by Age Group (n=292\*)**  
**Influenza Week 40 – 16 OCT 2009**

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27 states reporting lab- confirmed  
influenza deaths



\*Rate / 100,000 by Single Year Age Groups: Denominator source: 2008 Census Estimates, U.S. Census Bureau at:  
<http://www.census.gov/popest/national/asrh/files/NC-EST2007-ALLDATA-R-File24.csv>





**Have the risk groups changed?**

# Who is at risk?

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## **Risk groups have not changed since the spring wave**

- Children and adolescents still remain at the highest risk for acquisition
- Hospitalizations are highest in young children and decline with age
- Deaths increase with age but only up to 50-64 year old age group and then decline slightly in 65+ age group
- The majority of those who die and adults who are hospitalized have underlying conditions, including pregnancy



# Emerging Infections Program, Influenza Hospitalization

## **PEDIATRIC** HOSPITALIZATIONS BY UNDERLYING MEDICAL CONDITION\* -- I 2009 H1N1 (Apr 15-Aug 31)\*\*

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(N=465, 62% had  $\geq 1$  underlying condition)

<b>Medical Conditions*</b>	<b>n</b>	<b>(% N)***</b>
Asthma	166	(35.7)
Cystic Fibrosis	1	(0.2)
Other Chronic Lung Disease	23	(5.0)
Bronchopulmonary Dysplasia	5	(1.1)
Chronic Cardiovascular Disease	20	(4.3)
Chronic Metabolic Disease	14	(3.0)
Diabetes	6	(1.3)
Renal Disease	12	(2.6)
Neuromuscular Disease	24	(5.2)
Cerebral Palsy	13	(2.8)

\*ACIP recognized condition

\*\*excludes nosocomial

\*\*\*not mutually exclusive; exceeds 100%

Data as of 13 October 2009



# Emerging Infections Program, Influenza Hospitalization

## **PEDIATRIC** HOSPITALIZATIONS BY UNDERLYING MEDICAL CONDITION\* -- II 2009 H1N1 (Apr 15-Aug 31)\*\*

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<b>Medical Conditions* -- cont</b>	<b>n</b>	<b>(% N)***</b>
Hemoglobinopathy	31	(6.7)
Immunosuppressive Condition	21	(4.5)
Seizure Disorder, incl h/o febrile seizures	27	(5.8)
Upper airway abnormality	4	(0.9)
Prematurity	27	(5.8)
Developmental Delay	33	(7.1)
Pregnant	6	(1.3)

\*ACIP recognized condition

\*\*excludes nosocomial

\*\*\*not mutually exclusive; exceeds 100%

Data as of 13 October 2009



# *Emerging Infections Program, Influenza Hospitalization*

## **ADULT** HOSPITALIZATIONS BY UNDERLYING MEDICAL CONDITION\* -- I 2009 H1N1 (Apr 15-Aug 31)\*\*

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(N=685, 76% had  $\geq 1$  underlying condition)

<b>Medical Conditions*</b>	<b>n</b>	<b>(% N)***</b>
Asthma	211	(30.8)
Cystic Fibrosis	2	(0.3)
Other Chronic Lung Disease	98	(14.3)
COPD	69	(10.1)
Chronic Cardiovascular Disease	118	(17.2)
Chronic Metabolic Disease	160	(23.4)
Diabetes	136	(19.9)
Renal Disease	57	(8.3)
Neuromuscular Disease	18	(2.6)

\*ACIP recognized condition

\*\*excludes nosocomial

\*\*\*not mutually exclusive; exceeds 100%

Data as of 13 October 2009



# *Emerging Infections Program, Influenza Hospitalization*

## **ADULT** HOSPITALIZATIONS BY UNDERLYING MEDICAL CONDITION\* -- II

2009 H1N1 (Apr 15-Aug 31)\*\*

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<b>Medical Conditions*--cont</b>	<b>n</b>	<b>(% N)***</b>
Cancer, incl h/o lymphoma, leukemia	24	(3.5)
Immunosuppressive Condition	92	(13.4)
Seizure Disorder	21	(3.1)
Cognitive Dysfunction	15	(2.2)
Pregnant	76	(11.1)

\*ACIP recognized condition

\*\*excludes nosocomial

\*\*\*not mutually exclusive; exceeds 100%

Data as of 13 October 2009



# Underlying Conditions

## Deaths Case Series April to June 2009

Condition	≤18 years (%) N=48	>18 years (%) N= 251
Chronic Lung Disease	38	37
Asthma	17	19
COPD	0	17
Cardiovascular Disease	17	26
Neurologic Disease	52	12
Neurodevelopmental Disorder	38	4
Neuromuscular Disorder	35	5
Seizure Disorder	27	4
Other (non-spec., Alzheimer's)	13	4
Pregnant	4	6
Diabetes	0	24
Renal Disease	2	15
Cancer	6	16
Immune Suppression	5	24
Hepatic Ds, Hematologic & Metabolic Disorders	2	17
Obesity	7	50



78% persons with ACIP high risk medical conditions





## **Special Focus on Pregnancy**

# **Updated Information on Pregnant Women with H1N1 (April 15-August 21, 2009)**

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- **700+ pregnant women with confirmed or probable 2009 H1N1 influenza**
- **~ 100 pregnant patients admitted to ICU**
- **28 deaths in pregnant women among 484 total H1N1 deaths (6%)**
- **Pregnant women ~1% of the general population**

# Clinical Observations Regarding Pregnant Women with 2009 H1N1 Influenza

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- **Rapid deterioration**
- **Clinically fragile**
- **Generally prolonged ICU admissions**
- **Growing evidence that risk extends a few weeks postpartum**
- **Some experienced delays in treatment due to false negative rapid tests**

## **Additional Clinical Information on Deaths among Six Pregnant Women**

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- **All patients developed primary viral pneumonia with subsequent ARDS requiring mechanical ventilation**
- **Pregnancy outcomes:**
  - **5 with cesarean delivery (27-36 weeks gestation – 3 in ICU or ED),**
  - **1 fetal loss at 11 weeks**
- **Length of time from symptom onset to receipt of antiviral medication was 6-15 days (median 9 days)**
- **Length of time from presentation for medical care until receipt of antiviral treatment was 2-14 days (median 4 days)**

## Race - Ethnicity



# H1N1 Case Report Data

## Race/Ethnicity by Date of Illness Onset

This slides shows the decline in the proportion of Hispanics from the beginning to middle of the outbreak

**April 19 - May 3, n=647**

<b>Race/Ethnicity</b>	<b>n (%)</b>
White, NH	282 (44)
Black, NH	35 (5.4)
Hispanic	210 (32)
Native HI/Oth. Pac. Islander	2 (0.3)
Asian	13 (2)
American Indian/AK Native	20 (3)
Multiracial	4 (0.4)
Unknown	81 (13)

**May 4 - May 18, n=249**

<b>Race/Ethnicity</b>	<b>n (%)</b>
White, NH	125 (50)
Black, NH	17 (6.8)
Hispanic	58 (23)
Native HI/Oth. Pac. Islander	4 (1.6)
Asian	7 (2.8)
American Indian/AK Native	11 (4.4)
Multiracial	0
Unknown	27 (11)

**May 19 - June 16, n=26**

<b>Race/Ethnicity</b>	<b>n (%)</b>
White, NH	13 (50)
Black, NH	0
Hispanic	5 (19)
Native HI/Oth. Pac. Islander	0
Asian	1 (3.8)
American Indian/AK Native	1 (3.8)
Multiracial	0
Unknown	6 (23)

# Race/ethnicity of adult respondents with influenza-like illness (ILI) in the U.S., Behavioral Risk Factor Surveillance System (BRFSS),

Sept 1- Sep 30, 2009

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	ILI	Total	Weighted % ILI	Weighted (95% CI)
<b>Race/ethnicity</b>				
White, non-Hispanic	1026	22254	5.48	(4.87–6.10)
Black, non-Hispanic	121	2135	5.40	(3.68–7.13)
Hispanic	109	1934	3.83	(2.28–5.39)
Other race only, Non-Hispanic	74	1074	6.41	(3.77–9.05)
Multiracial, Non-Hispanic	43	435	13.2	(6.34–20.07)
Not asked or missing	18	310	4.12	(1.46–6.78)

This slide shows that all race-ethnicities have approximately equal incidence of ILI during the month of September

# Health care seeking behavior of adults respondents with ILI in the U.S., by race/ethnicity, BRFSS,

Sept 1- Sep 30

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	Sought medical care for ILI	Total	Weighted % Yes	Weighted (95% CI)
White, non-Hispanic	454	1026	41.4	(35.7–47.1)
Black, non-Hispanic	63	120	49.5	(33.3–65.7)
Hispanic	51	109	39.5	(20.6–58.4)
Other race only, non- Hispanic	35	74	40.0	(18.3–61.7)
Multiracial, non-Hispanic	24	43	48.5	(19.2–77.8)

This slide shows that all race-ethnicities have approximately equal incidence of seeking care for ILI during the month of September

# Influenza Associated Pediatric Mortality

## Distribution of laboratory-confirmed pediatric 2009 H1N1 and seasonal influenza deaths by race/ethnicity, 2009

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	<b>H1N1 deaths 4/14- 8/31/2009</b>	<b>H1N1 deaths 9/1- present</b>	<b>Seasonal Deaths</b>
Hispanic – any race (15%)	17 (35%)	6 (21%)	18 (25%)
White (67%)	19 (40%)	7 (25%)	30 (42%)
Black (12%)	6 (13%)	9 (32%)	13 (18%)
Asian (4%)	2 (4%)	1 (4%)	5 (7%)
Alaska Native or American Indian (1%)	0	1 (4%)	1 (1%)
Native Hawaiian or Pacific Islander (0.14%)	0	0	2 (3%)
Unknown race or race/ethnicity	4 (8%)	4 (14%)	2 (3%)
<b>Totals</b>	<b>48</b>	<b>28</b>	<b>71</b>

# Conclusions

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- H1N1 is now widespread over most of the US
- ILI Net rates are currently higher in October than they have been at the peak of the last 5 influenza seasons
- Hospitalizations are highest in the youngest children and decline with age, excess hospitalizations are highest in the 5-17 year old age group
- Deaths are lowest in the youngest children and increase with age but only up to 50-64 year old age group -- deaths decline slightly in 65+ age group
- The majority of those hospitalized and dying from flu have underlying conditions
  - Asthma is common among those hospitalized
  - Neuromuscular disorder is common among children dying from influenza
- Pregnant women are disproportionately affected by severe outcome
- Racial ethnic disparities in severe outcomes exist and warrant investigation